Telephone Engineer

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Sale of Service Convention No doubt the recent convention of the United States Independent Telephone Association will go down in history as a "Sale of Service" convention. Ever since the introduction of the telephone, the increasing demand for service has always run ahead of the supply of equipment and construction, until the last two years, when the demand suddenly slackened and in most communities an actual loss began to be felt.

Ever ready to meet emergencies, the more progressive companies began to consider ways and means of coping with the situation. Several of them put on special selling campaigns and in every case very flattering results were reported. Some of these campaigns were explained in detail at last year's convention and a general interest was aroused. At that time, however, information as to permanent results was lacking and it was with a great deal of interest that further reports were received this year from those who appeared on the program last year.

From all that we have heard on the subject we are bound to form the conclusion that the policy of making systematic efforts for the sale of telephone service is sound. Just a word of caution is in order. We should not permit ourselves to be blinded as to final results by the "flush production." The tele-

phone company suffers an actual loss in most cases where a subscriber does not keep the service and pay for it as long as three months. Therefore, to measure the real benefit obtained, it is probably necessary to deduct what was referred to by one speaker as the "infant mortality," that is those who do not retain the service as long as three months.

Then it is a well-known fact that a considerable portion of the new "sales" that are made during sales campaigns are nothing more nor less than the over the counter business that would have come in anyhow. Many of the so-called sales are made from prospects that have been turned in by the employe who happened to get hold of a copy of the evening paper first and read that Mr. Such a Man had joined the firm of So and So and would move his family to the city the following week. That isn't salesmanship. It is genius. The chances are one hundred to one that the order would have come in over the counter in the natural course of events.

When we have eliminated the short-lived subscriber and the subscriber that would have volunteered his order, we are in position to determine the tangible results of the campaign; and while, compared with the first reports, fraught with stories of expert salesmanship and dollars and dollars of annual revenue added, the results will be very disappointing, no doubt, in every case they will still be found worth while. Taking into consideration the losses suffered during this year, many companies will still show a net loss notwithstanding the fact that successful sales campaigns were put over. What would the loss have been if no sales effort had been made? One of the larger telephone companies has actually made 15,000 sales through the efforts of its employees during the first nine months of 1931 and yet it suffered a net loss of 10,000 stations during the same period. What would have been the net loss of this company without the sales campaign? Doubtless it would have been doubled.

R. A. Lumpkin of Mattoon, Ill., presented an analysis of the situation with reference to the results of sales campaigns conducted by his company that should be followed by every one in order that nobody be deceived by figures that do not represent facts.

However, in view of what has been accomplished we are in favor of the sales campaign idea first and last. Telephone companies have sat idly by and allowed the manufacturers and dealers in automobiles, pianos, radios, phonographs, washing machines and many other commodities to steal the monthly installment plan, originated by the telephone companies themselves. We believe the day of lethargy in this department of their business is past and that the inspiration and information gained at the 1931 convention will result in many dollars being turned to the telephone industry that would otherwise have gone into other channels.

Thomas Alva Edison

It was an emotional experience in the hearts of many men, when, in the dark hours of the early morning on October 18, word was flashed by telephone, by telegraph, by radio, that Thomas Alva Edison, the man who had a part in making the above modern conveniences possible, was dead.

Those of us who, regardless of whether we knew him personally, had honored, admired, and loved Edison for many years, found it difficult to realize that the light of this great mind—although it had made it possible for light to be permanently shed on the world—had gone out for ever as far as this Earth was concerned, and that Edison, after all, was mortal.

In spite of the fact that Edison, "The Wizard of Menlo Park," will take a high place among the great inventors of all time, and that his inventions seemed singularly marvelous and miraculous, he had a sententious modesty which refused to make a mystery of his genius. He was fond of saying that his "genius" was "about 2 per cent inspiration and 98 per cent perspiration." His own character stoutly supported this, for certainly one of the most remarkable of his qualities was his industry, his concentration, and persistence. He has said that up to 1902 he worked on an average of 19½ hours a day, and only later reduced it to 18. He has worked virtually without sleep for 60 hours.

When the great inventor was awarded a congressional medal three years ago he was addressed by President Coolidge as "noble, kindly servant of the United States and benefactor of humanity." Edison contributed so much to the progress of his generation that literally columns of space would be required to give an adequate idea of the extent to which the world is indebted to him. His accomplishments are everywhere in our life. If we thought of Edison every time one of his inventions performed a service for us, he would be in our minds most of our waking hours.

While he is generally thought of as having given to the world the electric light, the phonograph, modern telegraphy, and moving pictures, he was the father of a long list of important inventions and improvements. In fact, he took out more than 1,200 patents, although his actual inventions far exceeded that total.

In his first two years at Menlo Park he brought out the transmitter and receiver for automatic telegraph; and the carbon telephone transmitter as well as other improvements of the Bell idea, which netted him approximately $400,000.

In 1888 he discovered, unwittingly, the basis of the radio, known to science as the "Edison effect"—that a current of electricity is produced when a filament is heated in a vacuum tube. Practical appli-

cation of the "Edison effect" was made years later by Doctor De Forest.

So it seems that Edison was involved in almost every modern invention. Those he didn't originate he contributed to, or perfected. The world has become a different place because he was here for a time. And all the world mourns one of its greatest benefactors.

Annual Independent Telephone Convention

Business in Telephone Industry Better Than in Most Others Concensus of Opinion at Convention; MacKinnon Again Chosen President; Noted Economists Make Optimistic Business Forecasts; Radio Said to Be Important in Growth of Long Distance Telephony; Members of Pioneers' Association Urged to Make European Trip; Annual Pioneers' Luncheon Well Attended

Several startling predictions in the world of business, invention and the telephone industry were heard by those attending the Thirty-fifth Annual National Independent Telephone convention at the Hotel Stevens, Chicago, October 20 to 23rd.

Briefly summing them up they are as follows: That it is possible that eventually persons on the earth will be able to hold telephone conversations with the inhabitants of other planets; that television is imminent, although it is still too expensive for private consumption, but that it will never replace radio; that the United States is going to see at least fifty years of prosperity which will far exceed any that she has known; and that the next boom in land values is scheduled to take place on the outskirts of cities.

Diversified as these various statements undoubtedly are, there is not one of these predictions which was not based on a foundation of sound logic and past history; and not one which did not hold great interest for the telephone men attending the convention. The sources of these statements will be revealed further along in this report of the convention.

The convention was well attended, with a registration of more than 1,200, and delegates seemed to take an unusually enthusiastic part in the various meetings. Notes were compared on methods used to gain new business in different sections of the country, and telephone men constantly reiterated their belief that their business had been hurt by the unsettled business conditions, less than any other industry or business.

Pres'dent's Address

In his annual address, F. B. MacKinnon, president of the United States Independent Telephone association, said:

"This has been a year of progressive activity. It has been a year of aggressive activity. Our companies, faced with the necessity of holding their own, and realizing that their own position was a better one than that occupied by the most of the industries, have advanced new ideas, have organized their forces along new lines, and as a result have been taking a more advanced position than they otherwise would.

"Some of the companies have said that we are on a defensive line. Others said: 'No, it is time we were taking the offensive in these campaigns.'

"There are 246 companies that reported to the Interstate Commerce Commission for 1930; which are the last available figures we have.

"These 246 companies are operating slightly over two million stations. They had an investment in fixed capital of $352,000,000, so that as a group they are a very important factor in the commercial life of the country.

"The question has been as to how this group operated in 1930, as compared with 1929. What was the tendency?

"In 1929, the operating revenue of the A companies in proportion to fixed capital was 24.1 per cent. In 1930 it was 22.7 per cent. The ratio of the B companies in 1929 was 22 per cent, and in 1930 21.5 per cent. For the C companies in 1929 it was 24 per cent and in 1930 23.6 per cent. You will notice that there has been a slight decline in those percentages in all three groups.

"For the period ending July 31, figures show that the A class companies, that is, all of our companies and all of the Bell companies, had a shrinkage in revenue of only 1.6 per cent from the same period in 1930.

"The subscribers' station revenue was only about .2 of one per cent less for the seven months' period as against the same seven months' period in 1930; being practically no shrinkage. Message tolls fell off 5.3 per cent, so that the shrinkage for the period on total revenues was almost entirely in the toll business."

In continuing his address Mr. MacKinnon said these figures demonstrate a justification of the faith that telephone men have in the stability of their industry.

In speaking of the depreciation order just issued by the Interstate Commerce Commission he said it brings before the whole telephone industry the problem of carefully analyzing their operating expense accounts, their past practices in handling depreciation, maintenance and capital charges; and it will bring all before one tribunal of the Interstate Commerce Commission, and should bring some to a realization of the necessity of providing adequate depreciation charges, if they are going to have an honest telephone organization.

In discussing the proposed Couzins bill which would bring radio and telephone together under one governmental control, Mr. MacKinnon said the telephone industry still felt that the radio industry was not sufficiently standardized as yet to be dealt with together with the well established telephone industry.

"Keep your forces going, keep the service up; and remember that there is not a man in your community who can afford to be without a telephone," he said in closing.

Election of Officers

Mr. MacKinnon was again chosen to head the National Independent Telephone association as president. The following vice-presidents were elected: Houck McHenry, Jefferson City, Mo.; Henry A. Barnhart, Rochester, Ind.; and W. G. Brorein, Tampa, Fla. Charles C. Deering, Des Moines, Ia., was chosen secre-

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Sherman, Texas,
October 25, 1931.

Publisher TELEPHONE ENGINEER.
Chicago, Ill.

Gentlemen:

I am in receipt of the October number of TELEPHONE ENGINEER and want to congratulate you on the general appearance of the magazine, which, along with the vast amount of news and technical matter makes it the best yet, according to my way of thinking. You certainly are covering the field thoroughly and the liberal advertising patronage in this number shows that the publication is recognized by leading manufacturers and jobbers as being one of real worth.

Very sincerely yours,
C. A. SHOCK.

tary-treasurer, and the following were named as directors:

E. C. Blomeyer, Chicago; W. G. Brorein, Tampa, Fla.; W. H. Bryant, Mobile, Ala.; Charles C. Deering, Des Moines, Ia.; Hart F. Farwell, Terre Haute, Ind., E. R. Hannibal, Everett, Wash.; W. Roy McCanne, Rochester, N. Y.; W. J. Melchers, Owosso, Mich.; Samuel Tucker, Pleasanton, Kans., and George A. Yanochowski, Chicago.

Noted Economists Speak

Two of the important convention speakers were not telephone men at all, but leading economists. However, much that these men had to say proved to be extremely pertinent to the telephone field. One of these speakers was Dr. David Friday, an economist of Washington, D. C., whose subject was "The Future of Industry," and the other was Prof. R. E. Pattison Kline of Chicago.

Said Dr. Friday: "American leadership in technique and in production efficiency are the important factors in world industry."

He said these were the facts that all Europe overlooked while wondering why this new country of the United States of America has seemingly sprung up overnight into world supremacy.

Reminding us that in the 19th century England was mistress of the world financially, Dr. Friday said this was not because of her many colonies, as many believed, but the result of her historic industrial revolution which was followed by an era of inventiveness.

"This country now has assumed industrial and production leadership," Dr. Friday said. "Before the War it was in doubt as to whether the United States or Germany would take the lead. But the War decided it."

U. S. to Prosper Next 50 Years

He said because of this inventiveness and industrial leadership the United States would be the most prosperous country of the world for the next fifty years at least.

Dr. Friday said there was nothing alarming about the present commodity price situation. He said it was the result of the price revolution which came with the War—such as have come with every war in history. He said if history continues to repeat itself the next turn will be up. Then, after several years, he said prices will probably show a tapering off to a gradually lower level for ten years or more.

He predicted that in ten years the choice land in cities will be worth less than it is now. He said the automobiles have increased the available land twenty-five times, and because of this we are going to see the retail stores moving out toward the outskirts of cities, where parking of automobiles and shopping can be done more easily. Therefore, he said, the next land boom will be on the outskirts of the cities.

In his address, which was on "America in a World Neighborhood," Professor Kline reminded his audience how the world, which had once seemed so extensive, had grown smaller with the advent of fast boats, long distance telephones, and airplanes.

"Only as we sense our community can we plan our conduct properly," he said. "The world has now become a neighborhood; the greater is world prosperity, the greater is our prosperity."

Professor Kline said that for years this country had prided itself on its "splendid isolation," which, he said, it has never had. He reminded his hearers of the War of 1812, when the United States fought Spain, and listed other examples down through history including the World War and events following the War. He also listed products for which the United States is absolutely dependent upon other countries. All this was to show how it is absolutely impossible for any one country to isolate itself from others.

Relation of Radio and Telephone

One of the important addresses given at the plant division conference was that on "Relation of Radio to Telephony," by Ray H. Manson, chief engineer, Stromberg-Carlson Telephone Manufacturing company, Rochester, N. Y.

"The world neighborhood mentioned by Professor Kline has been made possible strictly through radio, as far as long distance telephony is concerned," he said.

He said that not only was the combined use of radio and telephone the popular method of conversing across ocean and seas, but that the radio vacuum tube had been incorporated into long distance telephone lines as a repeater.

However, he said, if the telephone had borrowed from the radio, so had the radio borrowed from the telephone, particularly as to its loud speaker, which is only an enlarged transmitter. In fact, he said the mechanics of the radio receiving set incorporate much of the telephone instrument.

"There was recently opened between New York and Chicago, a new cable with a frequency range of from 40 to 8,000 cycles. Only a range of between 250 to 3,000 cycles are necessary for audibility, but this smaller range does not give the fine shading of voices necessary to radio broadcasts, or for complete recognition over the telephone," Mr. Manson said.

"This new cable allows those in New York to listen to programs broadcast in Chicago with no loss in tones.

"Thus it is possible that by spreading out the frequency range and leveling it off the telephone will soon give persons complete recognition of the voice of the person at the other end of the line. And this has been gained by telephony from the radio."

Television Never Replace Radio

In discussing television, which he said was gradually being perfected, Mr. Manson suggested that the day perhaps was not far off when people will have private television receiving sets in their homes, even as today they have radio sets. At the present time he said television sets were too expensive for most people to own.

However, Mr. Manson said it was not likely that television ever would replace radio, but rather would take an entirely different part in people's lives. He said they were different in many respects, especially in that the radio could be turned on and the programs heard, while the persons in the home could go about doing other things, whereas television would require all the attention of the individual, since he must see the program as well as hear it.

Another difficulty also arises, according to Mr. Manson, in the fact that television requires 20,000 cycles per second. Since the best known in radio is 5,000 cycles per second, and no telephone will give 50,000 cycles per second, obviously television can't be broadcast over long distance. He suggested that each city would undoubtedly have its own television broadcasting station. For this reason, he said it would be impossible to show by television the landing of a trans-Atlantic pilot, World Series' baseball games, football games, and so on, except by taking motion pictures of the event and broadcasting them by television on the evening following the event.

He said the broadcasting of other television programs would necessarily be far different from radio programs, since the appearance of the performers would be as important as their voices or musical instruments, thus requiring that they memorize their lines, that they have regular stage settings, proper costuming and make-up.

Dr. Arthur Bessey Smith gave the report of the committee on American Standard Electrical Definitions. Dr. Smith is chief research engineer, Associated Electric Laboratories, Inc., Chicago. He said the standardization of terms and definitions had proceeded rapidly although it is still uncompleted in the division of telephony. He said there are 2,081 terms in all, approximately 400 of which apply to the telephone industry. Of these 400, 352 terms have been formally adopted, Dr. Smith said. Under each of the principal term definitions, there are dozens and sometimes hundreds of divisions and sub-divisions.

New Specifications for Poles

An explanation of the new standard specification for wood poles and a discussion of pole line engineering was given

with the assistance of lantern slides by A. L. Stadermann, chief engineer, Citizens Independent Telephone company, Terre Haute, Ind.

In tracing the history of telephone poles, Mr. Stadermann said in the early days they were made from any wood to be found in the neighborhood. This was found to be unsuitable in many instances, and gradually it came about that wood with a high fiber strength only was adopted for poles.

Later, certain specifications were required by organizations and companies. However, Mr. Stadermann showed by diagrams on his lantern slide how these specifications varied from one organization to another, resulting in much confusion in the pole industry due to this lack of uniformity.

"For many years both pole users and pole producers have wished for standard specifications for poles," Mr. Stadermann said.

"About six years ago this Association was requested by the American Standards Association to act as co-sponsor with the Bell companies in preparing specifications for wood poles. This work has now been completed after much careful research and mathematical labor. The new specifications should result in eliminating the confusion in the industry, and provide a single standard for all pole using companies as well as pole producers, and therefore result in the simplification of engineering work and lower construction costs."

Mr. Stadermann made a detailed comparison, showing the improvement of the new specifications over the old ones; and likewise a detailed consideration was given to the use of the new specifications in pole line design, particularly with regard to (1) strength of poles, (2) loads on poles, and (3) selection of poles.

Pioneers Discuss European Trip

Next summer's ten weeks' tour of Europe formed the nucleus of almost every address and report delivered at the annual meeting of members of the Independent Pioneers' Association held Thursday, October 22, at the Stevens hotel, in connection with the thirty-fifth annual convention of the United States Independent Telephone Association.

The tour, open to pioneers, their families and friends, sails from New York May 21, 1932, on the 20,000 ton cabin steamer, Caronia, of the Cunard line, and will be conducted through ten countries and all the principle cities of Europe. The purpose in planning this trip, as stated by Frank L. McKinney, president of the Pioneers, in his annual address, is two-fold; first, to provide the ideally managed and conducted trip abroad in order that telephone Pioneers might make this trip at a minimum of expense, and with a group of persons of mutual interests and friendships; and secondly, to make up the deficit in the treasury.

For it was brought out that although this group tour could be planned much more reasonably than an individual person could plan and take the same trip, since more advantageous rates can be secured everywhere for a larger group; still a reasonable profit can be realized by the Pioneer's treasury.

The treasurer, J. K. Johnson, said that although business had not been as good as usual, on the whole it had been a successful year. He said the Independent Pioneers now have a membership of 1,047, including a net increase of 14 additional members this year.

He urged members to sign the application for free insurance which is available with payment of their dues, saying that some members have failed to take advantage of this service, although it is entirely free, requiring only filling in the application and signing it.

P. Kerr Higgins, president of the Scotia Telephone company, University City, Mo., made a suggestion from the floor to the effect that deceased Pioneers be given the title of honorary member and their names accordingly kept on the rostrum of members. Mr. Higgins also spoke briefly of his own European trip last summer, advising members to take advantage of the group rates made possible next summer by the Pioneers' Association.

Safford Gives Pioneers' Address

It would seem that many telephone people are accustomed to making jaunts across the Atlantic. When Warren Safford, owner of the Troy Telephone company, Troy, Ohio, and former president of the Ohio Independent Telephone association, gave the annual Pioneers' address, he began with an introduction which mentioned a trip abroad last summer, and said that if he could make any of his experiences in Europe come alive with mere words, he would spend his entire allotted time telling the other Pioneers present about them, for then he was certain none of them would neglect to take next summer's trip if they could afford it. He said "see America first" is a good slogan, but that one should also see Europe, for "you can't see Europe in America."

In opening his address, Mr. Safford said that now, for the first time in the history of the telephone industry, men could in truth be called "Pioneers." The members of the Pioneers' association were more like explorers in the vast, new industry of telephony, than pioneers, he said.

Mr. Safford divided the history of the telephone industry into three periods, first, its inception, second, the hurried building of telephony into an industry, and third, the perfection of this communication industry. He said telephone men were still engaged in the second phase of the industry, which made all telephone men today, in truth, pioneers.

"This depression is very incidental to the entire history of the industry," Mr. Safford said. "Those working in telephony today are pioneers working for nearer perfection. Before us we see a mighty industry, measured in usefulness hardly begun, still far from its ultimate possibilities.

Communicate with Planets

"The objective of the telephone industry has been the linking together of every individual with any other individual with whom he wished to communicate. We started with the neighborhood, then came the linking together of a community, then a city, eventually communication was extended throughout a state, and then states and countries were linked together. Now it has become possible to converse, by wire and radio, almost around the world, helping to create a community of the entire world. Probably we eventually will be able to communicate with other planets. This sounds impossible, but a few years ago telephonic communication across the ocean, was considered impossible by most persons."

Mr. Safford said it was all right to mull over the days of the past, calling to mind the "good old days" when poles had as many as ten cross arms, and it was not unusual for telephone companies to defend their franchise with a shotgun.

But, he suggested, it is better in the long run to remember that the task of the telephone man is far from being finished, and as Pioneers, members of the Pioneers Association owe it to the industry to solve the problems today confronting the industry, thus carrying on the traditions of the Pioneers.

Frank L. McKinney was re-elected president of the Independent Pioneers, J. H. Johnston was again chosen secretary-treasurer, and two new vice-presidents chosen were: Fred Coulson, assistant general manager, United Telephone company, Abilene, Kans., and Gustav Hirsh, of Columbus, Ohio.

Annual Pioneers' Luncheon

The tenth annual luncheon of the Pioneers was held in the main ball room of the Stevens hotel, immediately following the annual Pioneers meeting. It was attended by more than 1,000 Pioneers and their families and friends. An orchestra provided music throughout the luncheon, after which a program of music, dancing, and comedy provided entertainment for two hours.

This luncheon and entertainment was made possible through the support of the following organizations:

Acorn Insulated Wire Co., Addressograph Co., American Cross Arm & Conduit Co., American Electric Co., Inc., American Electrical Works, American

Steel & Wire Co., Anaconda Wire & Cable Co.

Automatic Electric Inc., Bell Lumber & Pole Co., Belden Manufacturing Co., L. M. Berry & Co., Lynton T. Block & Co., Bond Electric Corp., Burgess Battery Co., Chicago Telephone Supply Co., Churchill Cabinet Co., Coffey-System & Audit Co., Comstock Cedar & Lumber Co., Cook Electric Co., Coffing Hoist Co., Dicke Tool Co.

Electric Storage Battery Co., Everstick Anchor Co., Fansteel Products Co., French Battery Co., General Cable Corp., Holtzer-Cabot Electric Co., Hemingray Glass Co., Indiana Steel & Wire Co., Indiana Telephone Bulletin, International Creosoting & Construction Co., A. J. Johnson Electric Co., J. K. Johnson.

James R. Kearney Corp., Kellogg Switchboard & Supply Co., Leich Electric Co., Lenz Electric Mfg. Co., Bell Lumber Co., Loomis-Clapham Co., Michigan Pole & Tie Co., Minerallac Electric Co., MacGillis & Gibbs Co., MacKinnon, F. B.

National Carbon Co., National Telephone Supply Co., Naugle Pole & Tie Co., Nelson & Kummerling, Page & Hill Co., Paragon Electric Co., Philadelphia Storage Battery Co., Public Utilities Fortnightly.

Republic Creosoting Co., Reliable Electric Co., J. A. Roebling's Sons Co., Sands Electric Co., Stromberg-Carlson Telephone Mfg. Co., Southern Wood Preserving Co., Spooner & Merrill, Inc., Taylor-Colquitt Co., Telkor, Inc., TELEPHONE ENGINEER, Telephony Publishing Corp., Teletype Corp., Texas Creosoting Co., and P. Wall Mfg. Supply Co.

Convention Exhibitors

The exhibition hall of the Hotel Stevens was the popular gathering place throughout the convention, and the exhibits attracted unusual attention from delegates and visitors.

The following organizations were among the exhibitors:

Addressograph Company, Cleveland, Ohio.

American Electric Company, Inc., Chicago.

Automatic Electric Inc., Chicago.

L. M. Berry & Company, Dayton, Ohio.

Lynton T. Block Insurance Company, St. Louis, Mo.

Bond Electric Corporation, Jersey City, N. J.

Burgess Battery Company, Chicago.

Churchill Cabinet Company, Chicago.

Coffey System & Audit Company, Indianapolis, Ind.

Coffing Hoist Company, Danville, Ill.

Cook Electric Company, Chicago.

Curtin-Howe Corporation, New York.

Do/More Chair Company, Elkhart, Ind.

Electric Storage Battery Company, Chicago.

Everstick Anchor Company, St. Louis, Mo.

Fansteel Products Company, Inc., North Chicago, Ill.

French Battery Company, Madison, Wis.

Highway Trailer Company, Edgerton, Wis.

Holtzer-Cabot Electric Company, Chicago.

J. K. Johnston, Indianapolis, Ind.

James R. Kearney Corporation, St. Louis, Mo.

Kellogg Switchboard & Supply Company, Chicago.

Kester Solder Company, Chicago.

Leich Electric Company, Genoa, Ill.

Lenz Electric Manufacturing Company, Chicago.

Loomis-Clapham Company, Chicago.

National Carbon Company, Inc., Chicago.

Naugle Pole & Tie Company, Chicago.

North Electric Company, Galion, Ohio.

Page & Hill Company, Minneapolis, Minn.

Philadelphia Storage Battery Company, Philadelphia, Pa.

Postal Telegraph-Cable Company, New York.

Public Utilities Fortnightly, Washington, D. C.

Reliable Electric Company, Chicago.

John A. Roebling's Sons Company, Chicago.

Sands Electric Company, North Chicago, Ill.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

Square D Company, Detroit, Mich.

TELEPHONE ENGINEER Publishing Company, Chicago.

Telephony Publishing Corporation, Chicago.

Unique Manufacturing Company, Inc., Chicago.

USL Battery Corporation, Niagara Falls, N. Y.

P. Wall Manufacturing Supply Company, Pittsburgh, Pa.

NOW SOLE OWNER OF ARIZONA TELEPHONE SYSTEM

Ownership of the Navajo-Apache Telephone System of Holbrook, Ariz., has been acquired by Lloyd C. Henning, who recently purchased the interest of W. B. Woods. Mr. Woods has been manager of the Holbrook exchange since 1906, the year in which the system was organized by the Mountain States company. In 1912 the system was purchased by Henning, Woods and Fred W. Nelson. Henning acquired Nelson's interest in 1924.

CITY WILL ASK FREE USE OF TELEPHONE WIRES

L. L. Anderson, St. Paul corporation counsel, will ask the Minnesota Railroad and Warehouse commission this fall to order the Tri-State Telephone & Telegraph company to grant the city free use of its lines for fire and police alarm service.

If the appeal fails he will take his request to the courts to test whether the telephone company is required to lend its lines for the alarm service.

Mr. Anderson outlined this procedure recently in a letter to the city council, which recently requested an opinion from him as to whether the city is entitled to free use of the lines. He has not delivered the opinion. The council has included $5,000 in the 1932 budget for payment to the telephone company for alarm service.

Mr. Anderson said this money will be returned to the city if it is decided the company must furnish the lines free.

AUTHORIZE MERGER IN INDIANA

The Indiana Public Service commission has authorized the merger of eleven telephone companies into the Indiana Associated Telephone corporation with headquarters at Madison, Wis.

Properties involved in the merger were the Lafayette Telephone company, Home Telephone company of Wabash, Home Telephone company of Elkhart County, Fayette Telephone company, Logansport Telephone company, Steuben County Telephone company, Greencastle Telephone company, Putnam County Telephone company, Royal Center Telephone company, La Porte County Telephone company and the Liberty Telephone Utilities company.

The commission's order authorizing the merger provided for the issuance of approximately $6,000,000 in securities by the purchasing company.

Methods for Locating Resistance Faults

Insulation Faults of High Resistance and Their Correction, Solutions of the Varley Networks, and Series Resistance Unbalances, Are Among the Topics Discussed Here in the Second and Last Installment of an Article by T. C. Henneberger and P. G. Edwards

Insulation Faults of High Resistance

In order to locate faults of high resistance, sensitive galvanometers and highly insulated bridges must be employed, and the fault locating methods must correct for factors peculiar to the locating of such faults. If the resistance of the fault is high enough to be comparable in magnitude to the normal insulation resistance of the faulty wire, the effect of normal insulation resistance must be taken into account. In the case of a high resistance wet spot, it may happen that all wires in the cable are affected to some extent by the fault so that no wire of high insulation resistance compared to the selected faulty wire is available for measurements.

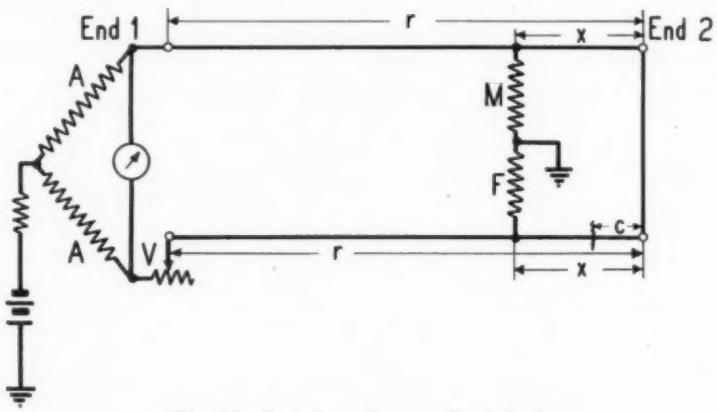


Fig. 10—Location of a resultant fault

The solutions of the Varley networks for high resistance faults are more readily obtained by approximate than by exact mathemathical reasoning, and will be worked out by the process of combining all of the "effective faults" on the wires into a single resultant fault and then solving the bridge network for this fault. The approximate solution is based on a principle which for the purposes of the present discussion can be stated as follows:

Any two shunt faults of high resistance along a wire can be replaced by a single resultant shunt resistance located between the two faults at a point the distance of which from either fault is directly proportional to the fault resistances.

Thus, if M and F are the resistances of two faults at separated points along a wire, and m and f are their respective distances from the resultant, then:

$$\frac{M}{F}=\frac{m}{f}.$$

The application of this "Rule of Resultant Faults" to Varley measurements can be shown as follows: Let M and F be the effective resistances of the faults on two cable wires at the same point along the cable; let r be the conductor resistance of either wire between the cable ends, and x the resistance of that portion of either wire which is between End 2 of the cable and the faults. Let V be the value of balancing resistance for a Varley measurement made from End 1, using a bridge with equal ratio arms, as indicated in Fig. 10.

Applying the Rule of Resultant Faults, the apparent location of the faults as determined by the Varley measurement will be at a point between the two faults, and at a distance from either fault which is directly proportional to the fault resistances. Let c be the resistance of the portion of the wire between the distance end of the cable and the apparent location. Then:

$$\frac{M}{F}=\frac{x+c}{x-c},$$

$$c=x\frac{M-F}{M+F}.$$

When the bridge is balanced for the Varley measurement:

$$c=\frac{V}{2}$$

Equating the two values of c and solving for x:

$$x=\frac{V}{2}\frac{M+F}{M-F} \qquad \ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Comparison of Formula (6) with the more exact Formula (2) for the same case indicates that the Rule of Resultant Faults will give accurate results only if the fault resistances are high compared to the conductor resistances, and if M is of appreciably higher resistance than F.

If M equals F, the location will be indeterminate: The two faults will have no effect on the balance point of the bridge and V will be zero.

Double Varley Method[1]

The distributed normal insulation resistances of cable wires can be considered, in so far as fault locating measurements are concerned, as though they were single resistances concentrated at some point along the wires (Rule of Resultant Faults). Consider two wires having equal and correspondingly distributed normal insulation resistances, N, which appear to be concentrated at some point b ohms from End 2 of the wires, and assume faults of effective resistances, M and F, on the wires at a point x ohms from End 2. Let r be the conductor resistance of either wire, and V_1 and V_2 the balancing resistances for Varley measurements from Ends 1 and 2 of the wires, respectively, using bridges with equal ratio arms as indicated in Fig. 11.

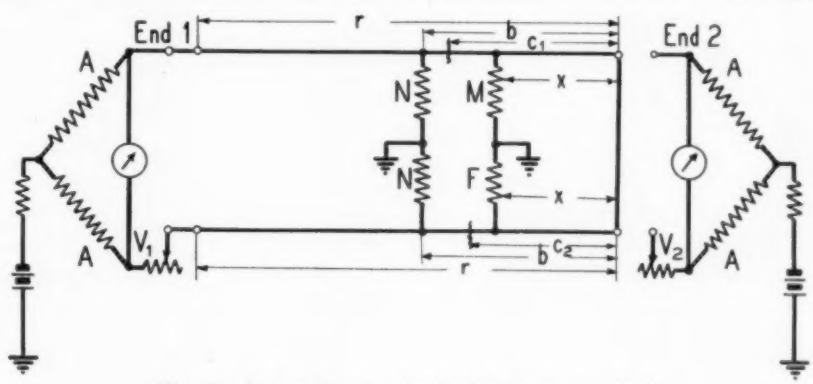


Fig. 11—Schematic circuit—double Varley method

Applying the Rule of Resultant Faults, let c_1 be the apparent location, in ohms from End 2, of the resultant M and N, and let c_2 be the corresponding location of the resultant of F and N. Then:

[1]The Double Varley method has been described in "Cable Testing," a paper read by E. S. Ritter before the Nottingham Centre of the Institute of Post Office Electrical Engineers (British), May 25, 1922. In that paper it is stated that the method is due to Mr. H. T. Werren.

$$\frac{M}{N}=\frac{c_1-x}{b-c_1},$$

$$c_1=\frac{Mb+Nx}{M+N},$$

and correspondingly:

$$c_2=\frac{Fb+Nx}{F+N}.$$

The equivalent resistance of the resultant of M and N is $MN/M+N$, and of the resultant of F and N is $FN/F+N$. Let c_3 be the apparent location in ohms from End 2, of the resultant of these two resultants, as indicated in Fig. 12.

Again apply the Rule of Resultant Faults:

$$c_3=\frac{Nx(M-F)}{M(F+N)+F(M+N)}$$

For the Varley measurement from End 1 of the cable:

$$c_3=\frac{V_1}{2}.$$

Equating these two values of c_3 and solving for x:

$$x=\frac{V_1}{2}\left[\frac{M+F}{M-F}+\frac{2MF}{N(M-F)}\right] \quad (7)$$

Likewise, for the Varley measurement from End 2 of the cable: $x=r-$

$$\left\{\frac{V_2}{2}\left[\frac{M+F}{M-F}+\frac{2MF}{N(M-F)}\right]\right\} \quad (8)$$

By equating the two values of x found in (7) and (8), the value of the "correction factor" for the Varley measurements can be determined:

$$\frac{M+F}{M-F}+\frac{2MF}{N(M-F)}=\frac{2r}{V_1+V_2}$$

Substituting this value of the correction factor in Formula (7):

$$x=\frac{rV_1}{V_1+V_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Likewise, the resistance of one wire between End 1 of the cable and the faults is:

$$(r-x)=\frac{rV_2}{V_1+V_2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Application: To apply the Double Varley method, ordinary Varley measurements, V_1 and V_2, are made from the two ends of the cable, using bridges with equal ratio arms, and the loop resistance, $2r$, of the wires is measured. The location, x or $(r-x)$, can be calculated from Formula (9) or (10), and then converted into feet in the usual manner.

Similarly, using the Rule of Resultant Faults, it can be shown that Formulas (9) and (10) also apply when only one of the wires used for Varley measurements is faulty. In this case the resistance, x, of the portion of the faulty wire between the distant end of the cable and the fault is:

$$x=\frac{V}{2}+V\frac{F}{N},$$

where V is the balancing resistance for a Varley measurement made from one end of the cable. This formula indicates that, where the ordinary Varley method (Figs. 5 and 6) is used, the insulation resistance of the "good" wire should be at least several hundred times as high as the fault resistance of the faulty wire. If this condition does not obtain the Double Varley method should be used. It will be clear, however, that the Double Varley method may be used, if desired, instead of the ordinary Varley method in cases where a wire of sufficiently high insulation resistance to be a "good" wire is available. In such cases the sum of the Varley balancing resistances obtained by measurements from the two ends of the cable will be equal to the loop resistance and Formula (9) will reduce to Formula (1).

The Double Varley method is workable only if the conductor resistances of the two wires used for measurements are equal. It can be shown that, if the conductor resistance of the wire having the fault, M, is r_m and that of the wire having the fault, F, is r_f, and if the normal insulation resistances of the wire are equal and uniformly distributed so that they may be regarded as concentrated at the middle of each wire, Formula (9) becomes: See formula 9 on page 38.

As indicated by the above discussion, the limitations of the Double Varley method are as follows:

1. There must be only one actual fault on any one cable wire.
2. The fault resistances must remain constant throughout a set of measurements to determine V_1 and V_2.
3. If both of the wires used for the Varley measurements are faulty, the faults must be at the same point on each wire, the resistances of the faults must be unequal, and the resistance of the fault on at least one of the wires must be high compared to the conductor resistance of the wire.
4. If the fault resistances are high enough to be comparable in magnitude to the normal insulation resistances of the faulty wires, the normal insulation resistances must be equal, and correspondingly distributed along the wires.
5. The conductor resistances of the wires must be equal.

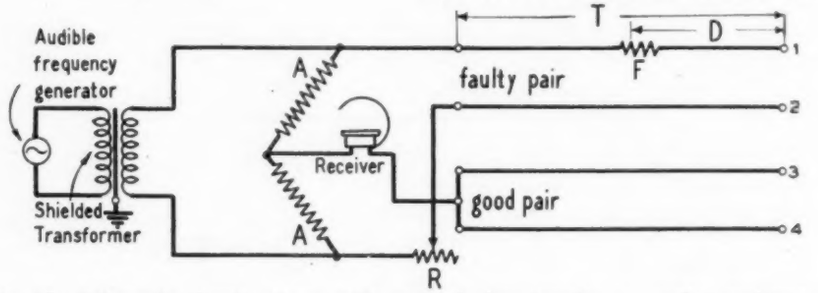


Fig. 13—Schematic circuit—short cable method for locating a series resistance unbalance

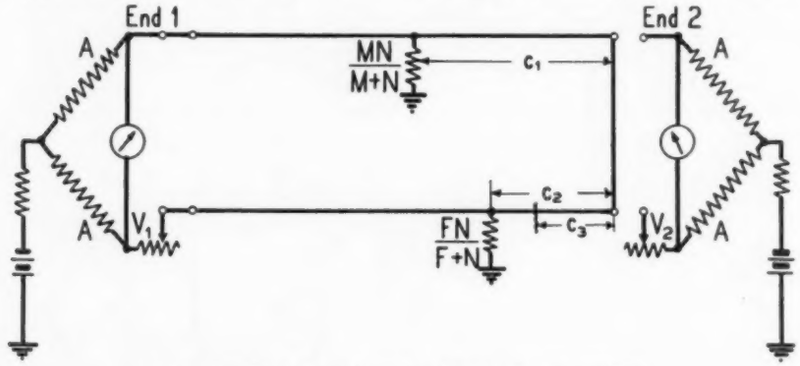


Fig. 12—Equivalent circuit—double Varley method

It will be understood that since the Double Varley method is applicable only when the resistance of the fault, M, is high compared to the conductor resistance of the wires, the Corrected Varley method or the Straight Resistance method should be used in cases where M is comparable in magnitude to the conductor resistances.

Series Resistance Unbalances

The methods for locating series resistance unbalances discussed in this paper involve essentially the balancing of the faulty wire against a "good" wire of equal capacitance by adding resistance to the "good" wire at the testing end until the effective impedances of the two wires are equal. A simple relationship then exists between the balancing resistance required, the resistance of the fault, the length of the faulty wire between the distant end of the cable and the fault, and the total length of the faulty wire. The circuit arrangement used depends on whether the cable under test is long or short.

(*Continued on page* 38.)

VACUUM TUBE THEORY AND PRACTICE

SUBJECT: TRANSMISSION MEASUREMENTS

General

A new type of instrument recently introduced by electrical instrument manufacturers has many applications in telephone plant testing.

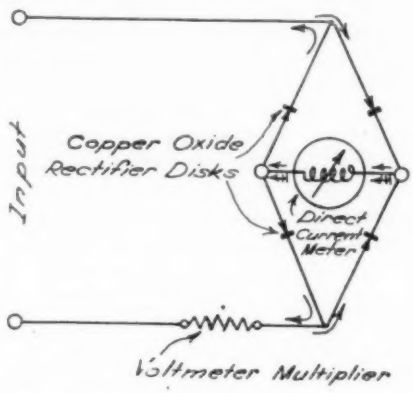


Fig. 1—Rectifier type voltmeter circuit

This instrument is known as the Rectifier Type Voltmeter, and consists essentially of a D'Arsonel type direct current micro-ammeter movement in series with a copper-oxide type rectifier.

It may be used to measure voltage of any frequency from one to 30,000 cycles with fair accuracy.

Ordinary A. C. voltmeters of the fixed coil magnetic vane type are only suitable for use on frequencies up to 133 cycles.

This article discusses the theory and use of the rectifier type voltmeter in telephone plant testing work.

Rectifier Meter Theory

Figure 1 shows schematically the circuit arrangement of a rectifier type voltmeter.

It will be noted that the copper-oxide discs are so arranged as to form a "bridge-type" full wave rectifier with the direct current micro-ammeter connected across the mid point of this bridge.

A resistance is placed in series with the rectifier to limit the current to the desired value for the voltages on which it is used.

Referring first to Figure 1, if an A. C. voltage is applied to the meter terminals the half cycle will flow through the upper left hand arm of the bridge rectifier and down through the meter, and the second half cycle will flow through the upper right hand arm of the bridge and down through the meter, so that both half cycles flow through the meter in the same direction resulting in a steady deflection.

The D. C. micro-ammeter is calibrated to read A. C. volts.

The copper-oxide rectifier used in this meter consist of copper discs coated with copper-oxide on one side, as shown in figure 2.

Discs arranged in this manner have the property of allowing current to pass from the copper-oxide to the copper, but not from copper to copper-oxide.

This rectifying principle is used in connection with battery chargers and other similar service.

Rect fier Voltmeter Uses in Telephone Testing

The rectifier type voltmeter is the first practical instrument which enables small telephone companies to make simple transmission tests which will give a positive indication of the talking efficiency of rural and local lines.

Using two voltmeters and a 1000 cycle oscillator small companies can quickly determine the overall loss of a rural line

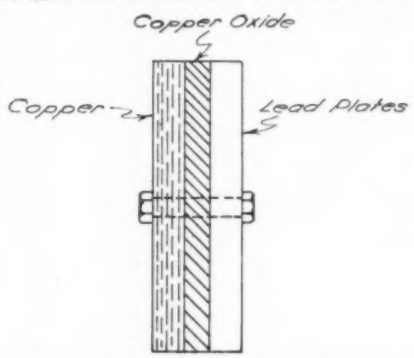


Fig. 2—Copper oxide rectifier element

or local subscribers loop in terms of the unit of transmission, the decibel.

Figure 3 shows the new Model 571 Weston Electrical Instrument company's multi-range rectifier type voltmeter.

This instrument is particularly well adapted to telephone testing as it is equipped with a dial switch which permits selecting any one of the five voltage ranges.

By means of resistance networks operated by the switch the impedance of the instrument is constant on all ranges, hence, readings obtained on circuits having fairly high impedance, are comparable on the different scales.

The transmission range is approximately 26 decibel when used with a General Radio company's model 213-B, 100 cycle oscillator.

The most important application of the rectifier voltmeter is the measuring of transmission losses of circuits as shown in figure 4.

This method consists in connecting a General Radio Model 213-B, 1000 cycle oscillator across the subscribers line at the switchboard and comparing the voltage input at this point to the voltage obtained at any point out on the line. The loss in db between the switchboard and some point out on the line can be determined by referring the ratio between output and input voltages to a decibel vs. voltage ratio table such as is shown in figure 5.

For example, if the voltage input to the line under test was 4 volt and the output voltage measured at the end of the line was 2 volts then the ratio of output to input would be

$$\frac{2}{4} \text{ or } 0.5$$

which corresponds to a loss of 6 decibel.

Referring to figure 5 it will be noted that it is necessary to shunt a 600-ohm resistance across the voltmeter used on the line in order than the line will be terminated in an impedance equivalent to that of the oscillator.

This testing arrangement works best when two voltmeters are used, one at the oscillator and one at the distant end of the line.

This method of measuring takes into account all the factors that affect transmission, and unlike simple resistance measurements, it tells the whole story.

The measured results in decibels should be compared to the computed loss of the circuit under measurements to determine if excessive losses exist in the circuit.

Fig. 3—Weston Model 571 output meter. (This meter especially well adapted to telephone testing.)

Measurement of Transmission Loss in Apparatus

In addition to circuit loss measurement, the loss in telephone equipment such as repeating coils, cord circuits, etc., may be accurately measured by means of the rectifier type meters and a 1000 cycle oscillator.

Figure 6 shows how repeating coils, and cord circuits can be checked for excessive transmission loss.

It is necessary to terminate the output of the equipment under measurement, in

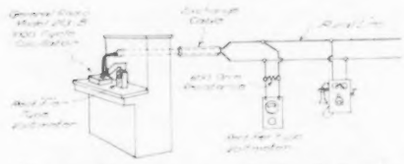


Fig. 4—Measurement of circuit losses

a 600-ohm resistance so as to avoid losses due to a mismatch of impedances.

This method is essentially the same as the method employed in measuring circuit losses.

Defective equipment such as low efficiency coil, reversed windings, low resistance drops, high resistance key contacts, etc., are all easily uncovered with this method.

In checking a number of cord circuits a defect in any of the cords is easily recognized by the reduced output voltage on that particular cord as compared to other cords.

Miscellaneous Uses of Rectifier Type Meters

Rectifier type meters have many other uses in addition to those described.

A few of the miscellaneous applications are listed below:

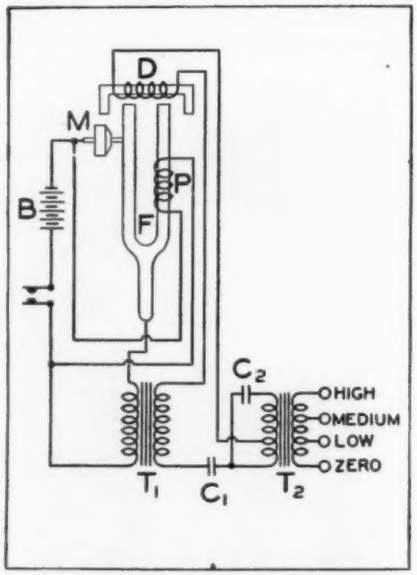


Fig. 8—Circuit general radio 1,000-cycle oscillator

1.—Checking the power output of radio receiving sets.

2.—Level indicators on public address systems.

3.—Measuring the output voltage of magneto generators, or ringing machines, or checking the voltage of 110 volt 60 cycle power sources.

4.—Measuring condenser capacity.

5.—Checking the output voltage of oscillators.

6.—Measuring the impedance of telephone equipment at 1000 cycles.

In connection with the shop repair of telephone instruments the rectifier type voltmeter is particularly useful in determining whether transmission of repaired equipment is up to normal.

Impedance measurements are made by connecting the equipment to be measured in series with a calibrated variable resistance and a 1000 cycle oscillator, the voltage drop across the resistance is then adjusted by varying the resistance so that the drop is the same as that across the unknown impedance. The impedance of the equipment under test is equal to the setting of the variable resistance.

1000 Cycle Oscillator

Transmission tests are made at a frequency of 1000 cycles as this represents

No. of db.	Power ratio	Current and voltage ratio	Power efficiency in per cent
1	.794	.891	79.4
2	.631	.794	63.1
3	.501	.708	50.1
4	.398	.631	39.8
5	.316	.562	31.6
6	.251	.501	25.1
7	.200	.447	20.0
8	.158	.398	15.8
9	.126	.355	12.6
10	.100	.316	10.0
11	.0794	.282	7.94
12	.0631	.251	6.31
13	.0501	.224	5.01
14	.0398	.200	3.98
15	.0316	.178	3.16
16	.0251	.158	2.51
17	.0200	.141	2.00
18	.0158	.126	1.58
19	.0126	.112	1.26
20	.0100	.100	1.00
21	.00794	.0891	0.79
22	.00631	.0794	0.63
23	.00501	.0708	0.50
24	.00398	.0631	0.40
25	.00316	.0562	0.32
26	.00251	.0501	0.25
27	.00200	.0447	0.20
28	.00158	.0398	0.16
29	.00126	.0355	0.13
30	.00100	.0316	0.10

Fig. 5—Decibel vs. voltage-current and Power Ratios.

the average voice frequency and it is standard practice to express losses in terms of this frequency.

An oscillator suitable for transmission measurement work is shown in figure 9, and the circuit of this oscillator in figure 8.

This type oscillator is very compact, and operates from four dry cells. It has an output fairly free from harmonics and the tuning fork method of controlling oscillations assures that the frequency will always be as specified.

Referring to figure 8, the operation of this type oscillator is as follows:

F is a tuning fork which vibrates at its natural frequency (determined by its dimensions), and causes the diaphragm of the microphone button M, which is mechanically coupled to the fork, to vibrate at the same frequency. The resistance of the microphone button varies in accordance with the motion of its diaphragm and causes a corresponding variation in the current which flows in a circuit consisting of the microphone button M, the battery B, and the primary of the output transformer T_1. An alternating voltage of the fork frequency is then produced at the secondary terminals of T_1, and alter-

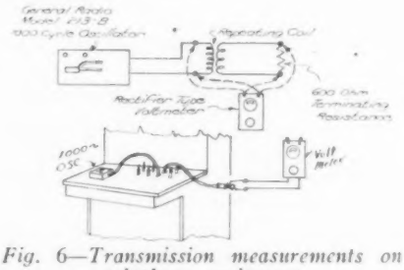


Fig. 6—Transmission measurements on telephone equipment

nating current flows around the circuit consisting of the secondary of T_1, the drive coil D, the condenser C_1, and the primary of the output transformer T_2.

A portion of the available energy is fed back through the drive coil to keep the fork in motion, and the rest is supplied to the load at the secondary terminals of the output transformer T_2. The condenser C_1 is used to shift the phase of the current through the drive coil to the value necessary to drive the fork. Since the fork is not permanently magnetized, a polarizing coil P is required to supply a

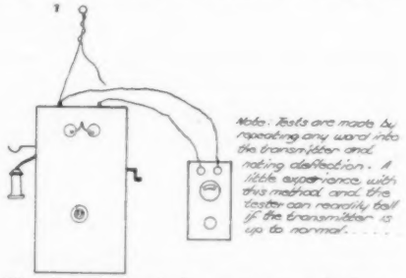


Fig. 7—Transmission tests on telephones

constant magnetic bias. Without this, the fork would be driven at twice its natural frequency.

The condenser C_2 and the primary of the output transformer T_2 form a parallel tuned circuit shunted across the load.

(*Continued on page* 36.)

Thanksgiving Finds Grateful Telephone Men

It Is Believed that Those Engaged in the Telephone Business Have Particular Cause to Be Thankful as Thanksgiving Day Approaches, and at the Request of This Publication the Following Have Written Their Reasons for Giving Thanks This Year.

Thankful for Safe Business

I am thankful I am in the telephone business because it is a safe business when economically managed, because it is a business that can be built up and up by enterprise, and because we have a substantial depreciation fund in cash with which we are giving work to needy men and at the same time making repairs which improve our property and increase the efficiency of our service.—Henry A. Barnhart, president Rochester Telephone company, Rochester, Ind.

Pleased with Industry Which Gives Value Received

Primarily, I am in the telephone business because I like it. It is more to me than just a means of getting the necessary things of life.

I am thankful that I am identified with an industry which gives more than value received for services rendered, and that to me is intrusted the responsibility of helping to provide this service for old and young, rich and poor, valuable alike in times of rejoicing or sorrow, and in times of prosperity of adversity.—W. C. White, wire chief, United Telephone company, Fredericksburg, Texas.

Good Will of Subscribers Brings Happy Feeling

To those who, during the 15 years of prosperity from 1914 to 1929, replaced depreciation, built up a good will among their subscribers, improved their service and were ready to meet "old man depression" I will say that it is a happy feeling we have on this coming Thanksgiving Day."—Samuel Tucker, president Pleasanton Telephone company, Pleasanton, Kans.

Grateful for Industry Which Gives Service Under All Conditions

It gives me great pleasure to have this opportunity of expressing my feeling of real Thanksgiving to our Good Lord for having directed me to engage in the telephone business, and for having permitted me to remain active in it for over 49 years. It would seem especially fitting at this time of extreme depression in the economic affairs of the world, that *everybody*, who is employed in the telephone business, should "Give Thanks" that they are engaged in a business that renders important service to humanity in times of peace, war, famine, or prosperity, and therefore a most necessary, and secure line of endeavor.—W. S. Paca, general manager, Petroleum Telephone company, Oil City, Pa.

Considers It Privilege to Engage in Telephone Business

I am truly thankful that I have been privileged to spend fifty years of my life in the telephone business—a business which has meant more to the progress of the world than any other one industry and which has never failed to give me a comfortable living.—P. Kerr Higgins, president and general manager, the Scotia Telephone company, St. Louis, Mo.

Telephone Man Today Luckier Than the Banker

A number of years ago, in talking before a group of managers of small telephone exchanges, I endeavored to impress upon them the importance of the industry in which they were engaged, its necessity to the business and social life of the community and concluded my remarks with the bold statement that the telephone business was entitled to as much, if not more, consideration and respect than the banking business and that the telephone manager should be held in as high esteem by the citizenship of the community as the banker. Then very few of my audience agreed with me. How many of them today are glad they are in the telephone business and not in the banking or some other business?—Frank H. Bohn, president, Home Telephone company, Fort Wayne, Ohio.

Glad Chosen Field Is Helping Create Better Fellowship

The lack of and the necessity for telephone service in the town in which I lived and the community within fifty miles thereabouts brought me into the telephone field.

I am thankful that I have lived and am living in an age which has seen the rapid development of telephone service to a point where it has become almost universal.

I am also thankful that my chosen field is one which is helping in its own way to create a better fellowship between all nations everywhere.—Hart F. Farwell, general manager Home Telephone company, Terre Haute, Ind.

Thankful for Interesting and Profitable Business

Years ago I figured that the telephone business had wonderful possibilities for the employe who would apply himself and stick to it. While I have not realized my entire ambition I am thankful for many things; the most important of which are, good health, good home, fine associates, both business and socially, and am in contact with and a part of an interesting and profitable business.—C. W. Kugelman, Portsmouth Telephone company, Portsmouth, Ohio.

Welcomes Opportunity to Help Develop An Industry

I am thankful that I am in the telephone business because I can devote my entire energy to the development of the telephone industry, since it is not necessary to waste any time or thought on competition or coercion of the fact that our industry gives the most value per dollar for business or pleasure that can be had. —F. O. Cuppy, Indiana state manager, Associated Telephone Utilities company, Lafayette, Ind.

Enjoys Personal Contacts of Telephone Business

I am thankful that I am engaged in the telephone business, not just because I enjoy the work and find my happiness in it, but because I have learned to love the men engaged in the same work, with whom I have come in personal contact. No doubt there are a few crooks in our business as in other lines of industry, but I have not met them. And last but not least, I am thankful for the good will and loyalty of our employees. Loyalty cannot be bought and is without price but is given you freely in response to personal application of the Golden Rule.—Houck McHenry, president Capital City Telephone company, Jefferson City, Mo.

Thankful for Confidence of Public

Let us be thankful not only for the splendid standard maintained by our companies through a world economic crisis but for the public confidence in our industry that will be reflected far into the future as a result. The telephone has doubly proven its value and its investment stability.—J. Warren Safford, Troy Telephone company, Troy, Ohio.

Happy to Render Worthy Service to Community

I am thankful to be in the telephone business because I am able to render a worthy service day after day to my com-

(*Continued on page 37.*)

Residence

Hold family reunions regularly by *telephone!*

"Season's greetings, son! . . . How is Helen? . . . and the children? . . . Oh, Dad and I are both well. . . . Let me talk to Jimmy, Junior, will you?"

* * *

FAMILIES scatter with the years. Too often they can't get "back home" for old-fashioned reunions. Then visit them by telephone! Distance doesn't matter. And telephone reunions are the least expensive kind. Best of all, you can have them all-year-round, any time, anywhere.

To most places 25 miles away, the day station-to-station rate is about 25 cents; 40 miles away, 35 cents; 75 miles, 50 cents; 125 miles, 75 cents; 150 miles, 80 cents. Many rates are lower during the evening and night periods.

Far from you... but near by *telephone!*

"Even the pup misses you, son! . . . How do you like your roommate? . . . You will be careful in football, won't you?"

* * *

Boys and girls may go to distant schools, but they're always near by telephone. Voice-visit with them often. A telephone chat is a sure cure for homesickness.

Use your telephone for frequent, friendly calls . . . when neighbors move to other cities . . . when the family is scattered on vacation . . . when there are weddings or birthdays or babies! It's easy, quick and inexpensive.

To places 25 miles away, the day station-to-station rate is about 25 cents; 40 miles away, 35 cents; 75 miles, 50 cents; 125 miles, 75 cents. Evening and night rates are even lower.

Toll Service

EXPLAINED IN TERMS OF BABIES, BIRTHDAYS AND ANNIVERSARIES

THE household telephone is not only a local convenience—useful in bringing a steak from the butcher's or making an appointment with the hairdresser—but also presents the pleasant possibilities of toll calls, formerly reserved for emergencies.

To show subscribers the many occasions for using toll service, advertisements like the two on the opposite page are appearing regularly in women's publications. They emphasize the ease and economy of residence toll service. They suggest appropriate occasions for its use—when there are weddings, or birthdays, or babies—when friends move to other cities, or children are away at school.

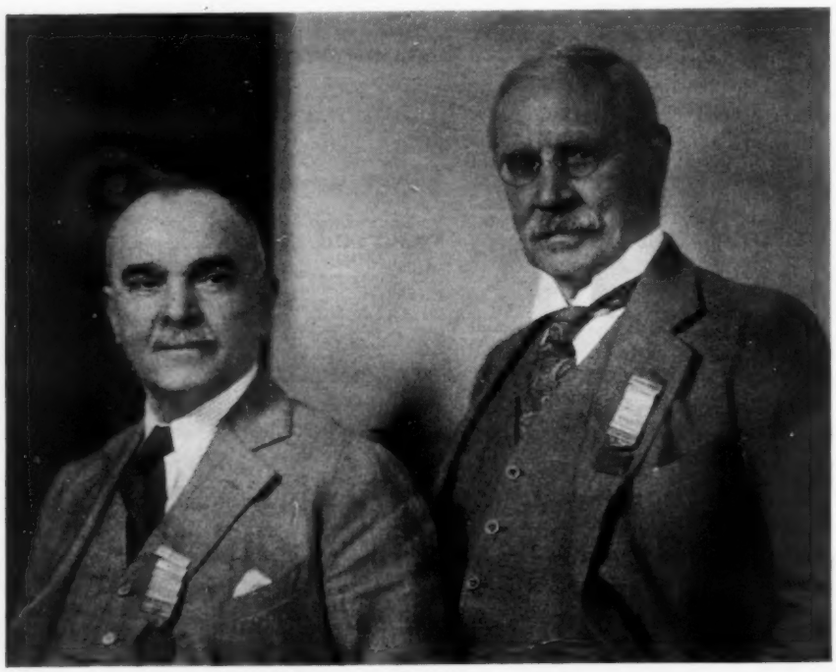
Advertising of this nature—seen by millions of women every month—encourages greater, wider use of toll service by customers of telephone companies everywhere.

An Advertisement of the American Telephone and Telegraph Company

Fifty Years of Telephone Service

P. Kerr Higgins, of St. Louis, and Francis Dagger, of Ontario, Canada, Both Started Telephone Careers in 1881, and Have Since Achieved Prominence in Their Respective Lines

Two telephone pioneers who have served for half a century in the telephone industry, celebrated their fiftieth anniversary in this field by attending the Thirty-fifth Annual National Independent Telephone Association convention held at the Hotel Stevens in Chicago, in October. These men are P. Kerr Higgins, president and general manager of the Scotia Telephone company, with headquarters in St. Louis, Mo., and Francis Dagger, Toronto, Ontario, Canada, supervisor of telephones for the Ontario Railway Mu-



Mr. P. Kerr Higgins, at the left, and Francis Dagger celebrate their fiftieth anniversary in the telephone industry

nicipal board (similar to the state commissions in the United States) for the Province of Ontario.

However, attending the National Independent Telephone convention is not an event in the lives of either of these men. Mr. Dagger claims to have attended every one for the last 27 years, while Mr. Higgins says he hasn't missed the last 26 conventions.

Started Careers in Europe

Both of these men began their telephone careers in Europe, and as a coincidence, both entered this field in September, 1881, when Mr. Higgins began as a boy operator in the National Telephone company, of Scotland, and Mr. Dagger started as an inspector of installing for the Lancashire & Cheshire Telephonic Exchange company at Wigan, England. He assisted in the installation of the first system in Wigan, and subsequently served as electrician at Burnley, Blackburn, and Preston.

Laughing a little reminiscently, Mr. Dagger, caught by interviewers between sessions of the convention, spoke of this first job of his, for which he received no pay for the first three months, after which his salary was ten shillings a week. He also admitted that he entered the telephone field because shortsightedness proved a barrier to the seafaring career he had already embarked upon. In fact before settling down to an eventful career on land in the telephone business, Mr. Dagger, who was born in Liverpool, England, June 3, 1865, had sailed thrice around Cape Horn, once around the Cape of Good Hope, once around the world, and had sailed across the Equator six times—and all this as an apprentice on a 700-ton sailing ship—a ship which today would be dwarfed beside even a small ocean-going steamer.

Mr. Higgins fared a little better than Mr. Dagger on his first job. He received three shillings a week at the very start. After eight years with the National Telephone Company of Scotland, Mr. Higgins was made Wire Chief (test clerk) for Scotland. The following year, 1890, he accepted a three-year contract as chief electrician for the Chili Telephone company, in Chili, S. A. And thus it was that Mr. Higgins reached the United States by way of South America.

Higgins Comes to U. S. In 1894

In 1894 he came to the United States, sought a position in Chicago, and accepted one as cableman with the Central Union Telephone company of Chicago. At that time, Mr. Higgins relates, cables were filled with paraffine or ozite and it was necessary to use the Kelvin D'Arsonville galvanometer with a telescope in locating cable trouble. Mr. Higgins became interested in cables and assisted F. B. Cook in developing cable protectors.

Later Mr. Higgins was made Chief Inspector in Indianapolis. And when the Pacific officials took over the C. U. T. company, he left for the Pacific coast and established a contracting firm called the Pacific Coast company. Later he was associated with the promoters of the Home Telephone company of Los Angeles as their superintendent of equipment, and still later became general manager of the United States Long Distance Telephone company. While he was connected with the latter company Mr. Higgins patented a police alarm system, and also the first protector using celluloid as a dia-electric.

In 1905 he entered the service of the Pioneer Telephone company, Oklahoma City, as superintendent of construction, and saw the company grow from very small beginnings to a state-wide system. About this same time he was also associated with and had an interest in the Clay County Telephone company for which he acted as manager. This was Mr. Higgins' first venture in telephone ownership.

Further Successful Ventures

About 1912 he took an interest in the Eureka Telephone company of Texas and was made general manager of the company. In 1913 he was made general manager of the Brazos Telephone company, which later grew into the Texas Independent Telephone System. He next became president and general manager of the Port Arthur Telephone company, leaving there about 1918 to become general manager of a group of six companies which in July, 1926, were incorporated and known as the Scotia Telephone company. Mr. Higgins has retained his position as general manager and annexed that of president since that time. He is also at the present time president and general manager of the Coweta-Porter Telephone

Watonga Exchange Has New Central Office

Western Telephone Corporation Supplies Common Battery Telephone Service with Full Metallic Cable Lines for Watonga, Okla. Stromberg-Carlson Central Office Equipment Used

By H. W. HUBENTHAL
Engineer for Oklahoma Utilities Association

On Saturday, October 10, 1931, the new office quarters and central office of the Western Telephone corporation at Watonga, Okla., were formally opened to the public. More than a thousand people of Watonga and surrounding towns viewed and inspected them.

The office is housed in a modern two-story brick building within one block of the business district. It is most conveniently located for centralized distribution of service lines, both to the business and residence sections of the town. The property of the company here consists of one quarter of a block of ground, affording ample storage room for line materials and parking space.

The manager's and cashier's offices, public waiting room and operating room are on the ground floor. A commodious operator's restroom has been provided. The plant and equipment room and store room are located in the rear of the building. The new central office equipment consists of a Stromberg-Carlson non-feature multiple common battery board. There are three sections having an ultimate capacity of 1,600 lines.

Special equipment consists of 20 rural and 15 toll lines, all lamp-ended. There are 15 universal type cord circuits to each position. A standard Stromberg-Carlson 1-B convertor in duplicate furnishes the ringing equipment. The central office battery, supplying current for the operation of the plant consists of a G. E. rectifier charging unit and a storage battery of 11 cells Exide type E. M. G. O. 7. The power board is of panel type, black slate. The plant maintenance department also includes complete wire chief testing equipment.

The outside plant, as well as the central office equipment, was completely rebuilt including full metallic cable lines. All wires enter the office building under ground. The cables terminating in the central office have a capacity of 1050 pairs, or 2100 wires. This gives the telephone company a surplus capacity to take care of nearly double the number of subscribers now connected to the exchange. The plant was cut over from magneto to common battery operation on September 12th last without a single case of trouble. The investment in the new plant represents an outlay of more than $60,000 and includes all new telephones as well as new central office and outside pole line equipment.

The exchange was open for inspection from 10 a. m. to 9 p. m. There were cigars for the men, flowers for the ladies and ice cream for the youngsters. In the evening the business men of Watonga tendered a banquet to the officers of the Western Telephone corporation in appreciation of the company's progressive spirit in giving Watonga this modern telephone equipment and service. Following the dinner Toastmaster Major Falkenstine of Watonga introduced H. J. Clark, vice-president and general manager; I. F. Krehbiel, assistant general manager; E. E. Miles, state superintendent; H. F. Rehg, director of public relations, and Harry ByBee, district manager, all of the Western Telephone corporation; Pete Winemiller, sales engineer, and D. C. Combs, state representative, both of Stromberg-Carlson Telephone Manufacturing company. All responded with remarks appropriate to the occasion.

Other out-of-town guests and telephone people were: M. A. Sanders, Oklahoma City, connecting company agent, Southwestern Bell Telephone company; Willard Clark, Guymon district manager and Dwight Cochran, Kingfisher, manager, Western corporation; W. G. Smithpeter, Geary, manager, Geary Telephone company; Harold Hubbard and Mrs. H. Hubbard, editor, Kingfisher Times; L. O. Machlan, Oklahoma City, manager, securities department, Western Telephone corporation, and H. W. Hubenthal, Oklahoma City, engineer, Oklahoma Utilities Association.

The Western Telephone corporation, of which Nathan L. Jones of Salina, Kansas, is president, and H. J. Clark, vice-president and general manager, owns extensive toll lines and operates 168 telephone exchanges in Oklahoma, Kansas, Missouri, Iowa, Nebraska and Texas. Twenty-seven of these exchanges are in Oklahoma.

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company of Oklahoma and president of the Port Arthur Telephone company, Texas.

Dagger Becomes Telephone Expert

Mr. Dagger remained in the telephone business in Europe for 19 years before coming to Canada in 1899, where he believed the field of telephony offered greater possibilities. After his first experience with the Lancashire & Cheshire Telephonic Exchange company, Mr. Dagger, in 1885, entered the head office of the Western Counties & South Wales Telephone company at Bristol, where he spent two years. From Bristol he went to Plymouth as manager of the Devon and Cornwall district for the same company.

It was in 1893 that all the telephone companies in England were merged into the National Telephone company, as a result of which Mr. Dagger went to Birmingham as superintendent of construction, and then to Sheffield on the same job.

Then he came to Canada, where he spent a year with the Bell Telephone company in Montreal, after which he went to Toronto where he branched out into the Indepedent field as a telephone expert and advisor. At this time he made a special study of telephone conditions on the North American continent with a view to determining the relative merits of public ownership, private monopoly, and competition.

Conducts Surveys and Campaigns

He prepared a report on this survey for Sir William Mulock, then Postmaster General of Canada, in 1903, which resulted in the appointment of a Parliamentary Select committee in 1905 to inquire into and report regarding the various telephone systems in operation in Canada and elsewhere. Mr. Dagger was asked to assist and advise this committee during its inquiry.

Mr. Dagger conducted an educational campaign for the Manitoba Government preliminary to taking a vote of the people upon the question of the public ownership of the telephone service, in 1906. He was also commissioned by the Government of Saskatchewan to investigate and submit recommendations enabling that government to enact legislation for the public ownership of local exchanges and long distance lines, and for the assisting of the rural communities to establish farmers' telephone systems, in 1907 and 1908. The withdrawal of the Bell Telephone company from the three prairie provinces was largely due to the activity and energy of Mr. Dagger.

He drafted the Ontario Telephone Act, 1910, acted in an advisory capacity to the

(*Continued on page* 50.)

Characteristics of Strowger Relays*

Discussion of Characteristics of Various Special Types of Relays Together with Explanations of Accompanying Graphs Which Show Details of Their Operation

By K. W. GRAYBILL
Research and Development Department, Automatic Electric, Inc.

A type of slow-acting relay is illustrated in figure 7 which incorporates a weighted vibrating spring. The weight is of magnetic material thus permitting it to be attracted against the core when the coil is energized. This operation closes a

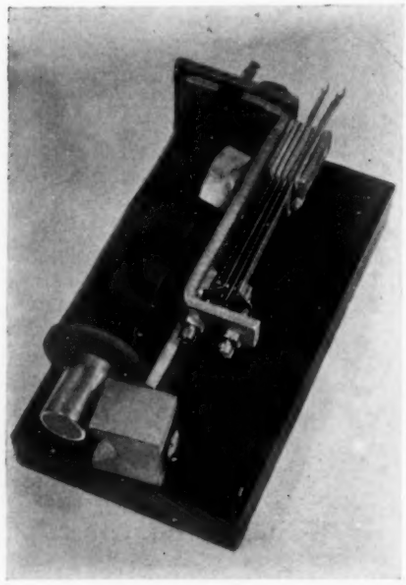


Fig. 7

circuit throughout certain contacts springs which are illustrated schematically in figure 8 as No. 3 and No. 4 springs of relay A. This circuit closure operates a slow-acting horizontal type relay "B" which closes or opens the circuits requiring the delay time. When the circuit to relay "A" is opened the weighted spring oscillates with a slowly decreasing amplitude. During the oscillations the circuit to relay "B" is repeatedly interrupted but due to its slow release characteristics it remains in the operated position until the amplitude of the oscillating reed becomes so small that the circuit to B is no longer closed. The reed finally becomes stationary with contacts Nos. 1, 3, and 4, all "open" or not in contact with the reed. The time required for the reed amplitude to reduce to a point which will release relay B is adjusted by varying the contact gap between springs Nos. 1 and 3 and the reed. The delay time which occurs after the circuit to A is opened before relay B releases may be varied from less than one second up to fifteen seconds.

Another type of oscillating spring relay used for slow operation is produced by modifying the horizontal type relay springs as illustrated in figure 9. Operation of the armature causes an armature spring to strike a make contact spring which is weighted. The weighted spring bounces out in the direction of operation opening the circuit between the armature spring and weighted spring. The weighted spring oscillates with a gradual decrease in the amplitude or distance of bounce until it finally comes to rest in contact with the armature spring. A circuit is closed through the armature spring and weighted spring to a slow to operate horizontal type relay as illustrated schematically in figure 10. The slow to operate relay "B"

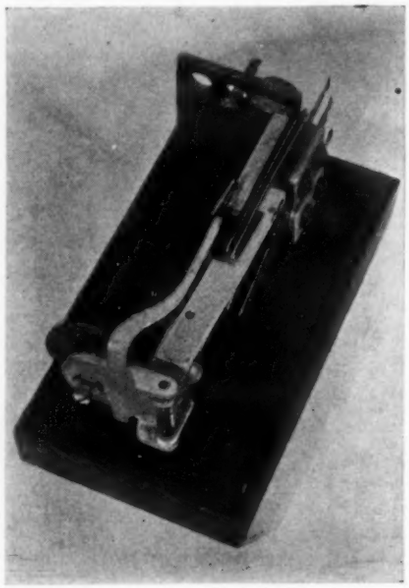


Fig. 9

does not operate until the oscillation of the weighted spring is nearly stopped. Additional springs may or may not be used on a second arm of the armature on relay A as required by circuit conditions. The delay time which occurs after the circuit to A is closed and before relay B operates may be adjusted from a fraction of a second up to two seconds. It will be observed this delay time occurs after the circuit to the weighted relay is closed whole the delay produced by figure 8 occurs after the circuit is opened.

A small sensitive relay designed for op-

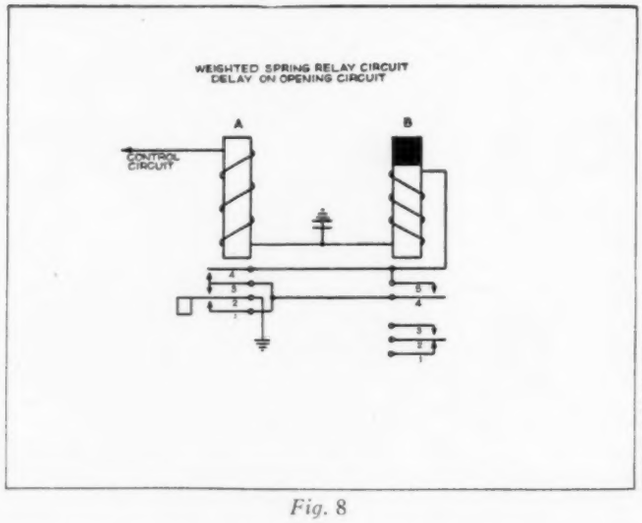


Fig. 8

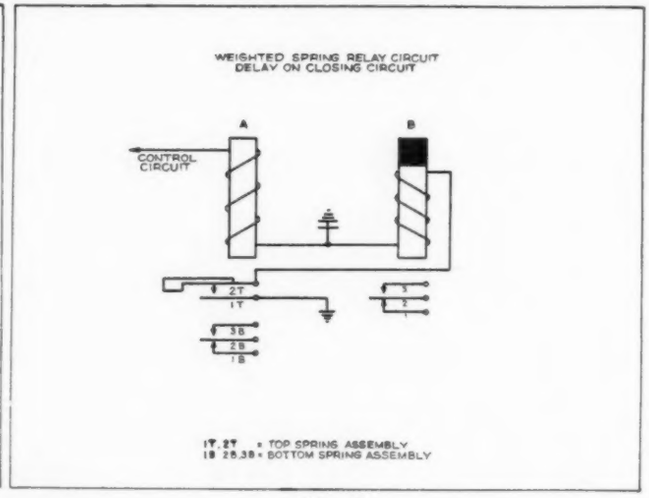


Fig. 10

*Editor's Note: This is the second half of article 5 of a series by Mr. Graybill dealing with relay characteristics. This is the final article of the series.

eration on alternating current is illustrated in figure 11. The core is built of silicon iron laminations. The coil is wound on a molded bakelite spool which slips over one side of the core section. The end of the core section opposite the armature is slotted and one-half of this core end is embraced by a small copper shading coil. Change in the flux through this shading coil results in a counter electro-motive force which builds up a local magnetic field in the core and armature of sufficient strength to hold the armature operated while the main flux is changing from one polarity to another. Because of this action the armature is held steadily in its operated position without chatter. The sensitivity of this relay when it is operated from 60 cycle commercial current is indicated by the pull curves in figure 12 which plots grams load against ampere turns. The value of ampere turns is obtained by multiplying the measured value of alternating current for any test condition by the turns in the coil exactly as done in direct current relay studies. A coil wound with 6,350 turns of No. 32 wire draws about .027 amperes on 60 cycle 110 volt commercial current and develops about 171 ampere turns.

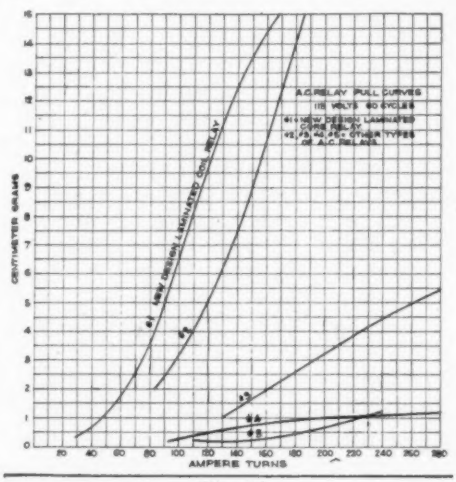


Fig. 13

The superior performance of this relay is indicated by a comparison of its pull curve on figure 13 with the pull curves of a number of other types of A. C. relays. The pull curves Nos. 2 to 5 on figure 13 are for other commercial relays and other proposed designs tested as a part of the development work on the relay illustrated in figure 11.

Figure 14 shows the minimum current required for this A. C. relay to operate a break make spring assembly having 30 grams back contact pressure and 25 grams make contact pressure for frequencies from 16 cycles to 66 cycles, when a coil of 9,300 turns of No. 35 wire is used. It is apparent that the performance of the relay is fairly uniform over the above frequency range. In practice it would be necessary to supply at least 20% more current than the values on chart No. 14 when considering the lowest voltage and maximum circuit impedance, in order to provide a factor of safety in operation.

To give a more definite idea of the decided efficiency of this A. C. relay structure figure 15 records the direct current pull curve for the relay with a .015 stroke on a centimeter gram-ampere turns basis in comparison with similar data for the horizontal relay. It will be observed

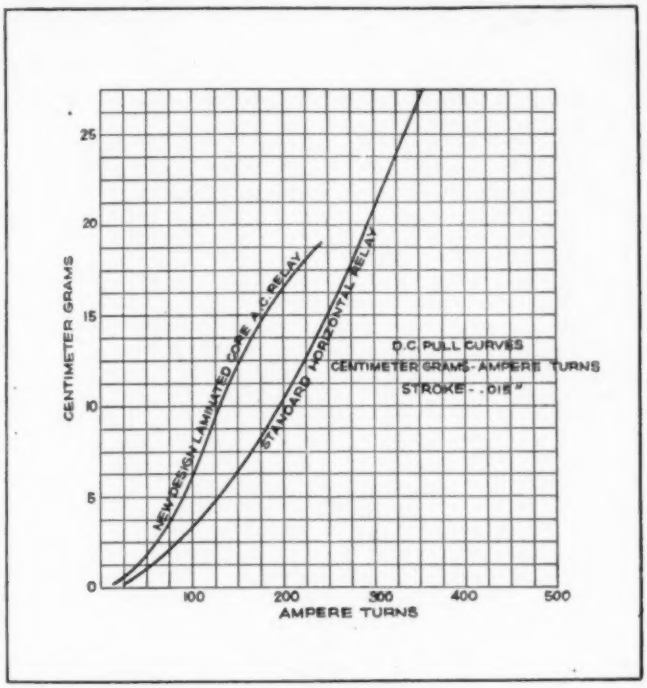


Fig. 15

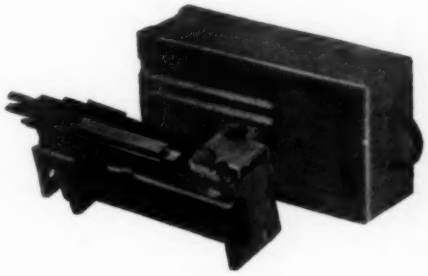


Fig. 11

that for certain values of ampere turns the A. C. relay structure will do nearly twice as much work as the horizontal relay.

This new alternating current relay is by far the most sensitive of the various commercial A. C. relays tested in the laboratory where it was developed. It will eas-

(*Continued on page* 49.)

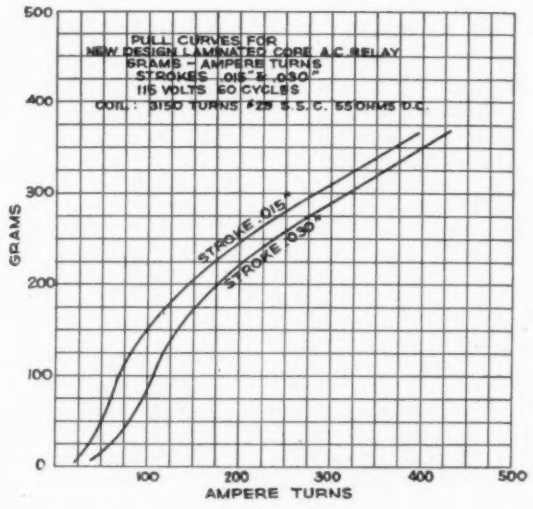


Fig. 12

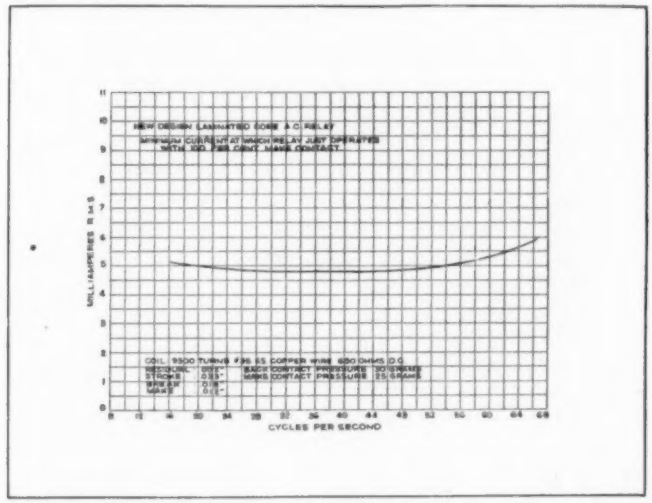

NEW DESIGN LAMINATED CORE A.C. RELAY
MINIMUM CURRENT AT WHICH RELAY JUST OPERATES
WITH 100 FMS CONT. MAKE CONTACT.
MILLIAMPERES R.M.S.
CYCLES PER SECOND

Fig. 14

Telephone Activities in Foreign Countries

Dispatches from Abroad Keep Telephone Men in United States Constantly Informed Concerning Telephony of the World; Domestic Telephone Problems Oftentimes Can Be at Least Partially Solved by Watching the Outcome of Experiments Made Elsewhere

Established 'Phone Service Between Argentina and Java (N. E. I.)

The telephone company has successfully extended a new telephone service between Buenos Aires and the island of Java, according to R. W. Bliss, ambassador to Buenos Aires.

Long Distance Improvements in New Zealand

The Chief Postmaster recently advised that as a result of the installation of voice frequency amplifiers at Christchurch and Timaru, communication between Wellington and Dunedin has been improved, and it is now possible to provide continuous telephone communication between Wellington and Invercargill. With the installation of additional apparatus at Christchurch and Timaru and at other points, it is now possible to provide facilities for continuous inter-communication between all important centers in New Zealand.

The initial installment in New Zealand of carrier current equipment comprises three single channel systems for use between Auckland and Hamilton, a three-channel system for use between Hamilton and Palmerston North, which will provide a single channel between Hamilton and Palmerston North, and two channels between Wellington and Auckland, and a single channel system to supplement the South Island land line section of the Wellington-Christchurch telephone circuit.

Revenue of Palestine Department of Communications

The business of the Department of Posts, Telegraph and Telephones of the Palestine Government during 1930 showed an appreciable increase over that for the previous year. Revenue amounted to approximately $1,098,915, as compared with $1,012,745 in 1929. The excess of revenue over ordinary expenditure was approximately $364,765.

Telephone Developments in British Malaya

Telephone communication has been established between the Posts and Telegraphs department, Straits Settlements and Federated Malay States, and between the Oriental Telephone and Electric company's exchanges in Singapore, and various exchanges as far as Kuala Lumpur, Federated Malay States, a distance of approximately 250 miles. Telephone communication in British Malaya has not kept pace with other developments and the recent opening of the line between Kuala Lumpur and Singapore marks the beginning of a service for which local business firms have been clamouring for many years.

The special trunk board in the office of the Oriental Telephone and Electric company, Limited, provides a carrier system of telephony which will eventually connect up the zone centers of Malaya, which are in Singapore, Tampin, Kuala Lumpur, Ipoh and Bukit, Mertajam (Penang). According to the Singapore Free Press, it is thought that it will be many years before the trunk traffic will be sufficiently heavy to necessitate the provision of cables underground. The present carrier system is transmitted over the existing telegraph circuits.

The present carrier system between Singapore and Kuala Lumpur is adequate for carrying out three conversations and four telegraphic communications between these two points. This system is already in operation between Kuala Lumpur and Ipoh. It is hoped that it will be possible to open up a similar line between Singapore and Penang before the end of the year.

Increase Telephone Facilities for Germany and Belgium

A long-distance telephone cable has been in operation between Brussels, Liege, and Hergenrath, on the German frontier, since 1926. As a result of the increased use of the line the Belgian Telegraph and Telephone authorities have lately placed a contract with the Siemens and Halske company, of Berlin, for the erection of a second line between Liege and the German frontier. The German authorities have also placed a contract for a second line between the frontier and Aix-la-Chapelle.

Telephone Service Opened Between Hong Kong and Canton (China)

The Hong Kong-Canton telephone line was opened for service September 1 by His Excellency the Governor of Hong Kong, Sir William Peel, and His Excellency Mr. Lin yun-chieh, chairman of the Kwantung Provincial council. The distance between the two cities is about 120 miles. The total cost of installation was approximately $455,000. Subscribers who desire to use the new service are required to make a deposit of HK$20 (one Hong Kong dollar equals about $0.24). Charges for a three minute station-to-station call amount to HK$2, with HK$0.65 for each additional minute, while a person-to-person call is HK$2.70 for the first three minutes and HK$0.90 for each additional minute.

In estimating the receipts for this line the average number of calls per day for the first year year has been placed at 600, while it is hoped to reach 1,000 calls during the second year of operation. This is the first long distance line operating in South China, and linking as it does the great commercial port of Hong Kong with the teeming Chinese business center of South China, it is hoped that it will repay those who are responsible for its promotion and completion.

Radio Service Available Between India and Siam

India and Siam were joined in radio communication September 1, when paid traffic was inaugurated between Calcutta and Bangkok. Messages will be received from 8:30 a. m., until 4:30 p. m., at the rate of eight annas (about $0.15) per word. Cablegrams sent via Madras will not be affected by this arrangement. This new service is the first instance of the Indian Posts and Telegraph department extending telegraphic communication outside India.

New Cable Between Italian Mainland and Sardinia

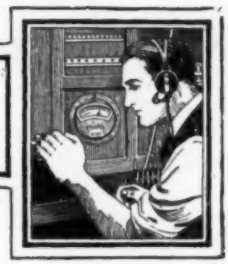
It has been announced that a new telephone cable will be in place early next year connecting Fiumicino on the coast at the mouth of the Tiber near Rome, with Terranova on the northeastern shore of Sardinia. The direct connection thus provided will be between the central interurban exchange in Rome and the telephone office at Sassari, the provincial seat in northern Sardinia. The cable will have a length of about 155 miles, declared to be the longest in the world of its particular type. The cost of installation is estimated at 12,000,000 lire ($631,000.)

Turkish Telephone and Telegraph Developments

The Istanbul-Sofia-Berlin telephone service which was announced as ready to function on May 1 has not yet started to operate. The telephone company said that certain technical difficulties have delayed the putting into operation of this service. It is expected, however, that these difficulties will soon be solved.

THE TECHNICAL CLEARING HOUSE

B. C. BURDEN, Editor



Locating the Decimal Point in Slide Rule Computation

Q.—What method can be used for locating the decimal point in connection with slide rule computations?

A.—In connection with division, multiplication, squaring, or extracting square roots by means of the slide rule, it is the general practice to locate the decimal point by inspection. For example in dividing a number such as 424 by 246 the slide rule shows the numbers in the answer to be 172 and it is apparent at a glance that the decimal point should be placed after the first number, that is, 1.72.

But in working with more complicated numbers and especially decimals, the proper location for the decimal point is not so easily determined, as is shown by the following example: Dividing a number such as .000424 by 2.46 the numbers in the answer are found to be 172, but in this case the proper location of the decimal point is not so readily apparent, and it is usually necessary to resort to several mental trial divisions of similar numbers to find the number of decimal places in the answer.

A method which permits the quick and accurate location of the decimal point is given on this page.

This method once learned will give the slide rule user much more confidence in the accuracy of his computations, and is to be recommended to the prevalent practice of locating the decimal point by guess or inspection. The explanation required to give a proper understanding of the use of this method is necessarily much more involved than the method itself, as is best illustrated by the fact that the method can be boiled down as shown in Fig. 1.

Figure one gives this rule in condensed form and is intended to be cut out and pasted on the back of the ten inch Manheim or similar slide rule.

The method for locating the decimal point in slide rule computation consists in first determining the "characteristic" of the two numbers involved and then applying a simple rule to find the "characteristic" of the answer.

The "Characteristic" of any number will either be positive, negative, or zero depending on the number of digits on the left hand side of the decimal point, or the number of ciphers on the right hand side, in the case of decimal fractions.

The following table illustrates what is meant by the term and how the "Characteristic" of any number is apparent at a glance.

Number	Characteristic
1111.0	+4
111.0	+3
11.0	+2
1.0	+1
.1	0
.01	—1
.001	—2
.0001	—3
.00001	—4

From the above table it will be seen the characteristic of whole numbers is always positive and equal to the number of digits to the left of the decimal point, and of numbers less than unity to be a negative number equal to the number of ciphers between the decimal point and the first number. The only exception to the above is numbers less than one having no ciphers between the decimal point and the first digit in which case the characteristic is zero.

After determining the characteristic of two numbers involved the proper one of the following rules should be applied to determine the characteristic of the answer:

Multiplication Rule:

a. If the slide goes to the left, the characteristic of the answer is equal to the algebraic sum of the characteristics of the multiplier and multiplicand.

b. If the slide goes to the right the characteristic of the answer is equal to the algebraic sum of the characteristics of multiplier and multiplicand, less one.

Division Rule:

a. If the slide goes to the left the characteristic of the answer is equal to the characteristic of the dividend minus the characteristic of the divisor.

b. If the slide goes to the right the characteristic of the answer is equal to the characteristic of the dividend minus the characteristic of the divisor plus one.

Squaring Rule:

a. If the answer falls on the left hand side of the rule, the characteristic of the answer is equal to twice the characteristic of the number squared less one.

b. If the answer falls on the right hand side of the rule the characteristic of the answer is equal to twice the characteristic of the number squared.

Square Root Rule:

a. If the number of which the square root is taken has an odd characteristic then add one and divide this by two to find the characteristic of the answer.

b. If the number of which the square is taken has an even characteristic then divide by two to find the characteristic of the answer.

The following examples illustrate the use of the above rules:

Multiplication:

Multiply on slide rule 243x410

Slide Rule gives 996 and slide goes to right.

and +3 characteristic of multiplicand
+3 characteristic of multiplier
+6 algebraic sum
—1 less one as slide goes to right
+5 is characteristic of answer

Therefore the answer will have five places and will be 99,600.

Division:

Divide on slide rule .0024 by 36

Slide Rule gives 667 and slide goes to left.

and —2 characteristic of dividend
+2 characteristic of division
—4 algebraic difference

Therefore the answer will have four zeros and will be .0000667

Squaring:

Square on slide rule .0012

Slide Rule gives 144 and answer is on left hand side of rule.

—2 characteristic of number
×2
—4 twice characteristic of number
—1 less one as answer is on left hand side of rule
—5 characteristic of answer

Therefore the answer will have five zeros to the right of the decimal point and will be .00000144

Square Roots:

Find the square root of 144

Rule gives

12
+3 characteristic is odd
+1
+4=2 adding one and dividing by 2 to get characteristic of answer
·2

Therefore answer will have two places and will be 12.

MULTIPLICATION		DIVISION		SQUARING		SQUARE ROOTS	
Slide to left. Sum of char.	Slide to right. Sum of char. less one.	Slide to left. Subtract char. of divisor from char of dividend.	Slide to right. Subtract char of divisor from char of dividend. Add	Answer to left. Twice char. of number; less one.	Answer to right. Twice char. of number.	Number has odd char. Add one to char & divide by two.	Number has even char. Divide char. by two.

Fig. 1—Condensed rules for location of decimal place. (Cut out and paste on back of 10" Manheim rules.)

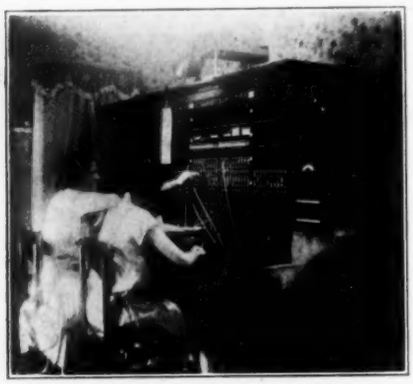
Chesaning Installs Kellogg Board

Telephone Company Brings Modern Service to Progressive Michigan Town by Installing New Kellogg Board

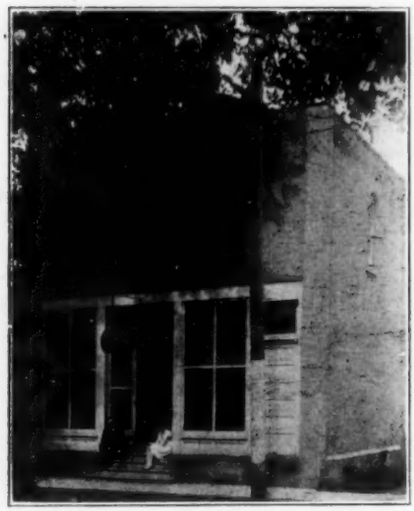
By J. L. TREVILLION
Representative Kellogg Switchboard and Supply Company

Chesaning, served by the Chesaning Home Telephone company, is a beautiful, prosperous town located in a fertile section of Saginaw county a few miles from the city of Saginaw, Mich. With its up-to-date stores, modern schools and churches, good roads and progressive people, Chesaning has a constantly increasing need for telephone service in its business and social life.

Since 1909, when the Chesaning Home Telephone company took over the operation of the plant, telephone service has been consistently improved, and the subscriber list has substantially grown. Further expansion took place last year when the company bought the Brant Telephone exchange, a system with about 100 subscribers.



Operators at the new Kellogg Universal switchboard installed by the Chesaning Home Telephone Co. at Chesaning, Mich. Note test panel at right of switchboard.



Central office building of the Chensaning Home Telephone Co., at Chesaning, Mich.

To keep up with the growing telephone needs of Chesaning and surrounding territory, the company recently completed the installation of a new Kellogg two-position Universal switchboard. The change in equipment has made it possible for the company to give more efficient and faster service, with a resulting increase of subscriber satisfaction. Although the company began with only 209 subscribers, today its operators serve over 630 subscribers, and complete approximately 70 long distance and 3,000 local calls daily.

The company maintains a neat, well-equipped central office and an excellent outside plant. G. M. Peet, president of the telephone company, is also president of the Peet Packing company, Chesaning's largest industrial plant. Charles W. Cheeney is secretary and manager, and has the care of the outside plant under his supervision. The installation and maintenance work of the exchange is ably handled by J. D. Ward, plant chief. These men attribute a large share of their successful telephone service to the reliable and efficient Kellogg switchboard.

NORTH ELECTRIC DISPLAYS "ALL RELAY" DIAL

The North Electric Manufacturing company had on display in their booth at the recent national telephone convention at the Stevens hotel, Chicago, their "all relay" dial system.

The concern demonstrated what it believes to be the fundamental superior value of relay selection, with a farm line twenty miles long, having twenty stations on the line. The line was grounded and permitted a 5,000 ohm leak.

The possibility of applying dial operation to a magneto plant without outside rehabilitation was shown.

The number of years in which "all relay" selection has been made available by the North Electric Manufacturing company proves the reliability of this system and the desirability of "all relay" selection was demonstrated in the display.

Another feature of this exhibit which aroused considerable interest was the demonstration of changing over from magneto to common battery, one line at a time.

The North Electric Manufacturing company believes that the telephone industry, with particular emphasis on the small magneto plants, which may now be operating with small earnings, can be put on a more profitable basis with equipment from its concern.

This concern has not only devoted the time of its executives and employes to design and manufacture, but has conducted some economic studies which the operating man is certain to be interested in. The exhibit of the North Electric company gave evidence of the application of these studies.

The operating company is dependent upon the manufacturer for the advancement in the design of equipment, not only to meet the requirements of the subscriber, but also in having available equipment which will permit the operating company to meet the economic problems encountered in operation.

The telephone industry is composed of operating and manufacturing companies, and it is only with a full understanding of the problems of the operating company that beneficial supplies can be provided by the manufacturing company. The evidence of this understanding on the part of the North Electric Manufacturing company was clearly shown in its convention exhibit.

KEYSTONE TELEPHONE CO., SHOWS PROFIT

Keystone Telephone company, for the first nine months, had net profit of $306,703 available for reserve, Federal taxes, dividends and surplus, compared with $338,298 last year.

Gross earnings for the nine months amounted to $1,577,743, compared with $1,664,274 in the corresponding period in 1930.

For the 12 months ended September 30 the company had gross earnings of $2,117,481 and balance, after expenses, of $427,809. These figures compare with $2,198,680 and $460,910, respectively, for the previous 12 months.

TELEPHONE FROM TRAINS IN ENGLAND

The Canadian National Railways having proved the practicability of telephone service by radio from moving trains; the British London and North Eastern railway has been conducting a series of experiments designed to enable passengers on the run from London to Edinburgh to keep in touch with other phones throughout the British isles. Engineers of the railroad are also experimenting with telephony for cab to caboose, and engineer to conductor.

Sales of the Western Electric company for the first nine months of the year amounted to $171,536,000, which compares with $282,545,000 during the same period in 1930.

KNOW THE POLES YOU BUY

The
BROWN
quality and service
are
dependable

When You Buy
BROWN POLES

You get:

The finest quality of Dense Southern Yellow Pine, selected and cut from Brown's timber holdings in Alabama, Florida or Mississippi, by Brown's trained woodsmen.

Careful inspection at assembly point in the woods by competent inspectors. Each pole marked showing date and size or class.

Poles stored in well-drained yards on treated ramps for proper seasoning under the watchful supervision of technical Superintendents.

Grading and framing before treatment done with accuracy and precision by polemen of long experience. Double inspection before treatment.

All poles treated by the standard Rueping empty cell process at Brown's modernly equipped 2-cylinder plants. The hit-or-miss methods of old inadequately equipped plants eliminated by more accurate methods and precise equipment.

Only AWPA grade No. 1 creosote oil used in the treatment of poles, every tank car of which is carefully tested. Well equipped laboratory at each plant where frequent oil tests are made.

Penetration tests with increment borer made on every charge immediately upon withdrawal from cylinder as your safeguard against unsatisfactory treatment.

Prompt shipments carefully loaded made from either our Brownville, Alabama or Louisville, Kentucky plants—Try us.

Brown Wood Preserving Co.

4th and K Sts., Louisville, Ky.

News From the Field

The Associated Telephone Utility system's special sales campaign has resulted in the gross addition of 28,000 new telephones throughout its area. In September the additions alone numbered 1,200 telephones.

The Associated Telephone and Telegraph company's South American subsidiary, Compania Telefonica Central, has just completed and put into operation a 600-mile toll line connecting Buena Ventura, the west coast port of entry in Colombia, and other cities of this section, with the capital, Bogota.

The Kansas Telephone company has permanently discontinued the installation fee of $1.50 for telephones. Fifty towns in the state will be affected.

Seven thousand feet of new cable have recently been installed by the telephone exchange at Peshtigo, Wis.

An upward swing in the telephone business has been indicated at Akron, Ohio, where 1,864 new telephones were ordered from the Ohio Bell Telephone company in September.

Henry A. Barnhart, president of the Indiana Telephone Association addressed members of the Northeastern Indiana Telephone Association assembled for an all-day meeting October 5 at Fort Wayne, Ind.

Canada's seven major telephone systems are cooperating in the construction of an additional transcontinental telephone line over 4,263 miles between Halifax, N. S., and Vancouver, B. C., for completion by the end of 1931. In 1930, 1,447 pole-line miles were built and 1,627 remained to be constructed in 1931.

The Marseilles Telephone company, Marseilles, Ill., has purchased a new building which contains newer and larger quarters for the telephone exchange, and a new Kellogg switchboard has been installed.

The Blanchard Telephone company, Blanchard, Okla., which recently rebuilt its entire telephone system, changing to metallic lines, has moved into new quarters.

Construction of additional aerial and underground cable facilities has been started in Neenah and Menasha, Wis., by the Wisconsin Telephone company. An expenditure of $21,000 is involved. The work will be completed late this year.

The Mutual Telephone company exchange at Assumption, Ill., is in the process of being remodeled, converting it from a magneto to a battery system. All lines in the city will be underground cables, laid in conduits.

Three Indiana telephone companies have filed petitions with the public service commission seeking permission to enter a merger with the Associated Telephone and Utilities, Inc., Petersburg, Pike county, Ind. The companies are the Midwest Consolidated Telephone company, Oaktown; the Bruceville Telephone company and the Freeland Telephone company.

A number of old telephone lines owned by the Ohio Standard Telephone company are being rebuilt in Peebles, West Union, and other Ohio towns.

Farmers between Sheldon and Jump River, Wis., are financing construction of a telephone line. Patrons will be served from the Sheldon exhange at a flat fee per phone.

Construction of a new exchange at Sheldon, Wis., is under way by the Rusk County Rural Telephone company.

Sale of the Central Bridge Telephone Company, Inc., which furnishes telephone service in and about the village of Central Bridge, N. Y., to the New York Telephone company was approved recently by the public service commission.

The J. Epps Brown Chapter No. 35, Telephone Pioneers of America, with headquarters at Charlotte, N. C., is considering Wrightsville Beach, near Wilmington, N. C., as the place of its 1932 summer convention.

Gillette, Wyo., will be provided with new central office equipment and converted from a magneto to common battery system according to the 1931-32 budget of the Mountain States Telephone and Telegraph company which allows $15,000 for the above improvements.

Additional telephone facilities involving expenditures of $256,000 and requiring 61,000 man-hours of labor are being provided in Virginia by the Chesapeake and Potomac Telephone company of Virginia, in anticipation of continued growth of service in the area.

An order from the Pittsburgh & Lake Erie Railroad company, for 45 units each of 4½ KV-A, 2300-volt rating, is announced by the Dubilier Condenser corporation, New York City. The units are the standard Dubilier 5 KV-A units, weighing 73½ lbs., and measuring 5x17x21 inches. They are to be installed at Colona, Pa., for power-factor improvement.

VACUUM TUBE THEORY

(*Continued from page 24.*)

This circuit is tuned to resonance at the fundamental oscillator frequency and acts as a filter to prevent harmonics from reaching the load.

The output top marked medium has an impedance of around 500 ohms, hence offers a fairly good impedance match to the average telephone line or equipment.

This oscillator is manufactured by the General Radio Company, of Cambridge, Massachusetts.

Additional Notes on Rectifier Type Meters

There are several characteristics of rectifier type meters which are worth considering, although these characteristics in no way affect their usefulness.

Where rectifier type meters are used on frequencies above 1500 cycles up to

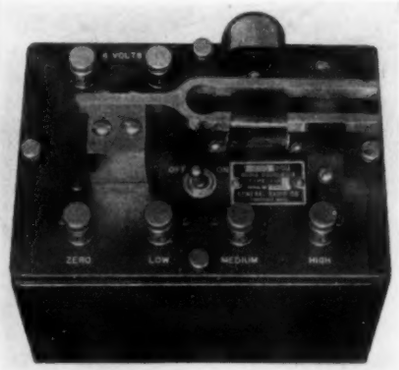


Fig. 9—General radio 1,000-cycle oscillator especially designed for telephone testing

35,000 cycles the actual reading should be corrected by a factor of 0.5 per cent for each 1000 cycles.

Another factor which is interesting to know, is the fact that in rectifier type meters the resistance of the meter is not constant but varies with the current passing through the meter.

This variation of resistance is calibrated into the scale of the voltmeter and results in no error so far as instrument indications are concerned.

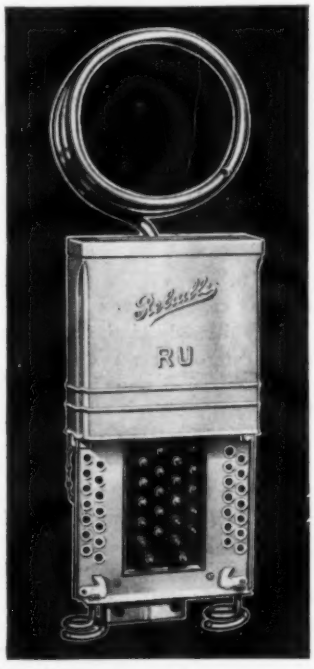
The fact that resistance varies with the deflection of the meter is of no serious consequence except where a fairly low resistance meter might be used on a high resistance circuit.

The voltmeter previously described has a resistance of approximately 4000 ohms which is sufficiently high to prevent appreciable errors due to changing resistance.

There are several other possible sources of error such as temperature and wave form but they are small and not of consequence in connection with general testing work.

RELIABLE ELECTRIC INTRODUCES NEW UNPROTECTED CABLE TERMINAL

In answer to the growing need in the telephone field for improvement in unprotected cable terminals, the Reliable Electric Company spent two years in research work along this line. Its first problem was to simplify the installation of cable terminals. To do this it found that the most feasible idea for mounting terminals onto poles or buildings was to have a detachable bracket, one which the



Improved unprotected cable terminal introduced by Reliable Electric Co.

construction crew could place in position and later the splicer could install the terminal proper when ready to splice it in. In view of this improvement, only one size bracket is needed for the 11, 16 and 26-pair terminals.

Durability was another of their problems. To insure that the terminal chamber will last as long as the cable the core box was made of cast iron. This and the sheet steel parts were heavily galvanized to withstand the most severe weather conditions. The cover is of heavy sheet zinc. To improve on weatherproofing and make for ease in wiring some distinct and novel features were added—a flat fanning plate which necessitates the jumper wires entering from the rear of the terminal and the sliding cover which surrounds these jumper wires in the back of the fanning plate completely eliminating all direct openings into the terminal chamber.

Other features embodied are: The catches to hold the cover in a raised position, the beveled washers which are easily separated, the notches inside the face plate which fit fins on the binding post screws and prevent them from being turned, the high grade bakelite face plate, the rings for guiding the jumpers and the fact that the terminal can easily be reversed.

THANKSGIVING FINDS GRATEFUL TELEPHONE MEN

(*Continued from page 25.*)

munity and to those seeking contact with my community.

Telephony is not threatened by the rapid changes in this and other countries, but to the contrary, as civilization progresses the telephone becomes more necessary as an aid in overcoming that great barrier, distance. And I am thankful.—Ernest Wommack, plants superintendent, De Queen Telephone company, De Queen, Ark.

PIONEERS OF AMERICA ELECT OFFICERS

Delegates to the eighteenth annual meeting of the Telephone Pioneers of America, an organization of veteran telephone employes from various parts of the country, elected officers recently at their closing session in the Hotel Pennsylvania, New York City. The organization includes employes who have been engaged in telephone work for twenty-one years or more, numbering about 20,000. There are about forty-one local chapters.

F. H. Reid, president of the Mountain States Telephone and Telegraph company, was elected president, to succeed Burch Foraker, president of the Michigan Bell Telephone company. A. B. Elias, president of the Southwestern Bell Telephone company, was elected senior vice president. Other vice presidents elected were: W. T. Belt, Northwestern Bell Telephone company; F. A. Montrose, Indiana Bell Telephone company; A. J. Allen, Ohio Bell Telephone company; C. G. Stoll, Western Electric company, and Miss Mary G. Cox, New York Telephone company.

CONVENTION SCHEDULE

Illinois Telephone Association, Pere Marquette Hotel, Peoria, November 18 and 19.

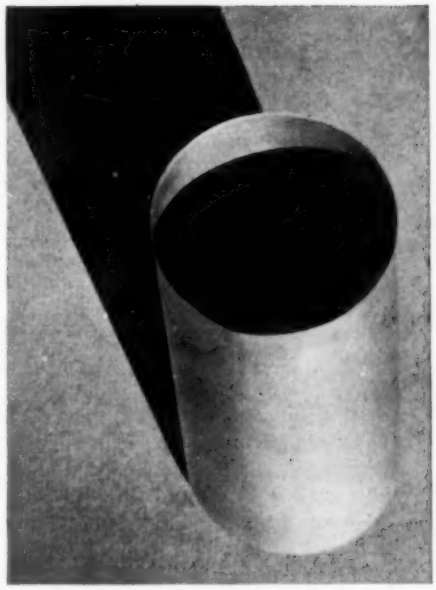
Canadian Independent Telephone Association, Carls-Rite Hotel, Toronto, November 18 and 19.

Nebraska Telephone Association, Hotel Paxton, Omaha, February 9, 10 and 11, 1932.

FOR SALE

This month only. Brand new three conductor brown desk stand cords, $15.00 per hundred. Also brand new Bakelite mouthpieces for W. E. transmitters. $5.00 per hundred.

W. M. Miller & Sons,
2553 Madison St., Chicago, Ill.



NO USE FRYING A BAD EGG

You can always be sure that Storm King Duro Powr Telephone Batteries are fresh and full of energy. No matter how long they stand on the Jobber's shelf or in your storeroom the seamless zinc cup and the specially processed air-tight top seal keep the original energy intact—no leakage, no evaporation, no entry of moisture, no corrosion, no electro couples. Duro Powr is your insurance against sending out a crew with a half dead cell that you think is O. K. because it has never been hooked up.

GENERAL DRY BATTERIES
INCORPORATED
CLEVELAND, O.

Makers of all types of dependable Dry Batteries for Radio, Ignition, Flashlight and General Use.

METHODS FOR LOCATING RESISTANCE FAULTS

(*Continued from page 22.*)

$$x = r_f \left\{ \frac{\frac{V_1}{2}[2MF + N(M+F)] + \frac{r_f - r_m}{2}[MF + N(M+F)]}{\frac{V_1 + V_2}{2}[2MF + N(M+F)] + (r_f - r_m)[MF + N(M+F)]} \right\}$$

Formula 9

The circuit arrangement for applying the test to short cables is shown in Fig. 13.

The wires 1-2 and 3-4 form the pairs of a quad containing a series unbalance of resistance, F. The total length of the faulty wire is T, and the length of the portion of the faulty wire between the distant end of the cable and the fault is D. The bridge has equal ratio arms, A, and a balancing resistance, R. The audible frequency generator is a buzzer or other source of relatively low frequency current.

The bridge is balanced first with the distant ends of wires 1, 2, 3 and 4 open, and then with the distant ends of wires 1, 2, 3 and 4 connected together. The location of the unbalance from the distant end can be calculated from the formula:

$$D = T\sqrt{\frac{R_o}{R_c}},$$

where R_o and R_c are the balancing resistances for the measurements with the distant end open and the distant end short-circuited, respectively. This test is suitable for use only on non-loaded cable, up to a few miles in length.

The bridge arrangement for applying the test to long (either loaded or non-loaded) cables differs from that for short cables in that the wires of each pair, 1-2 and 3-4, are connected together at the distant end when measuring R_o, and a testing current of very low frequency is used. A battery, reversed either manually or by means of a motor-driven commutator, provides a satisfactory source of current, as indicated in Fig. 14.

With the wires of each pair, 1-2 and 3-4, connected together at the distant end as shown, the balancing resistance is adjusted to a value R_o at which no deflection of the galvanometer occurs when the battery is reversed. The two short-circuited pairs are then connected together at the distant end, the reversing switch is left in one position, and the rheostat is adjusted to a value R_c to balance the bridge. The location of the unbalance from the distant end is:

$$D = T\frac{R_o}{R_c}.$$

As will be clear from the following discussion, both the formula for the short cable method and that for the long cable method are based on the assumption that the wires under test are of short electrical length. Theoretically, either method could be used with cables of any physical length provided the testing frequency were chosen properly. The specific measuring schemes described here are well adapted to practical application, however.

Short Cable Method[2]

When the bridge measurement is made with the distant ends of wires 1, 2, 3 and 4 open, as shown in Fig. 13, the impedance of wire 1 to 3-4 is compared to the impedance of wire 2 to 3-4. Assume a testing current of sufficiently low frequency that the wires are electrically short. Calling the capacitance and the conductor resistance of the length $(T-D)$ of each wire, C_1 and $(r-x)$, respectively, and of the length D of each wire, C_2 and x, respectively, the bridge circuit of Fig. 13 is practically equivalent to that of Fig. 15.

The impedance presented to the bridge terminals by the network containing F can be determined by inspection to be:

$$Z_1 = \frac{r-x}{2} + \frac{\frac{1}{j\omega C_1}\left[\frac{r}{2} + F + \frac{1}{j\omega C_2}\right]}{\frac{r}{2} + F + \frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}},$$

where j is the operator $\sqrt{-1}$ and ω is 2π times the testing frequency.

Likewise, the impedance presented to the bridge terminals by the network containing R is:

$$Z_2 = R + \frac{r-x}{2} + \frac{\frac{1}{j\omega C_1}\left[\frac{r}{2} + \frac{1}{j\omega C_2}\right]}{\frac{r}{2} + \frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}}$$

When the bridge is balanced, these two impedances are equal, so that:

$$\frac{r-x}{2} + \frac{\frac{1}{j\omega C_1}\left[\frac{r}{2} + F + \frac{1}{j\omega C_2}\right]}{\frac{r}{2} + F + \frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}} = R_o + \frac{r-x}{2} + \frac{\frac{1}{j\omega C_1}\left[\frac{r}{2} + \frac{1}{j\omega C_2}\right]}{\frac{r}{2} + \frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}},$$

This equation reduces to:

$$\left[\frac{r}{2} + F + \frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}\right]\left[\frac{r}{2} + \frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}\right] = \left[\frac{1}{j\omega C_1}\right]^2 \frac{F}{R_o}.$$

For a testing current of relatively low frequency the capacitative reactances, $1/j\omega C_1$ and $1/j\omega C_2$ are much larger than the resistances, r and F, and the above equation can be written as follows, the symbol $=$ being used to denote "is practically equal to":

$$\left[\frac{1}{j\omega C_1} + \frac{1}{j\omega C_2}\right]^2 = \left[\frac{1}{j\omega C_1}\right]^2 \frac{F}{R_o},$$

$$\sqrt{\frac{R_o}{F}} = \frac{C_2}{C_1 + C_2}.$$

Since C_2 is proportional to the length D and $(C_1 + C_2)$ to the total length, T:

$$\sqrt{\frac{R_o}{F}} = \frac{D}{T}.$$

When the bridge is balanced to the value R_c, with the distant ends of wires 1, 2, 3 and 4 connected together, the amount of unbalance between wires 1 and 2 is measured. Assuming that F is the only unbalance present, and that the conductor resistances of wires 1 and 2 are equal:

$$R_c = F$$

and therefore:

$$D = T\sqrt{\frac{R_o}{R_c}} \qquad \text{.....(11)}$$

Application: It will be clear from the above theory that Formula (11) will give accurate results only if the following requirements are met:

1. The resistance, F, must be the only unbalance on the wires.
2. The resistance of the unbalance must remain constant throughout a set of measurements to determine R_o and R_c.
3. The conductor resistances of wires 1 and 2 must be equal.
4. The capacitive reactances of wires 1 and 2 to 3-4 must be large as compared to the conductor resistances of the wires and the fault resistance.
5. Capacitance unbalances of wires 1 and 2 to 3-4 must be negligible.

In general, the short cable method is suitable for locating, with a fair degree of accuracy, series resistance unbalances ranging from a few ohms to several hundred ohms on non-loaded cable not exceeding three or four miles in length. In cases of unbalances of only a few ohms resistance, however, it is essential that the wires of the faulty quad be very well balanced in conductor resistance; and the bridge rheostat should be variable in steps of 0.1 ohm. Usually, best results are secured when measurements are made from the cable end nearer the fault.

The bridge voltage used should be as small as practicable in order to minimize changes in fault resistance. A sufficient number of separate determinations of the

[2]The short cable method is described briefly in the paper, "Cable Testing," by E. S. Ritter, loc. cit.

"STEWART" Cable Tester

Trade in your old cable tester, any make, on a STEWART Cable Tester with balanced coil. One user says: "I have tried them all, and the STEWART is the only one that will always locate water trouble." Price, complete with receiver and exploring coil, $57.00.

Sent on Trial.

STEWART BROTHERS
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Cedar Poles

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Prompt Shipment from Minneapolis Yard.

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YOU CANNOT LOSE

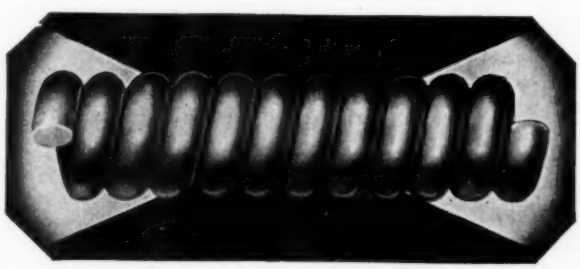
Most every telephone man knows about the Coffey System-Central Accounting Department—many have been using it for years. If you don't know how it can save you money and place your accounting second to none, write today for particulars.

Heretofore, the drawback to the smaller Company was the expense of getting started, but we have now arranged to handle this without expense to you, and your charge begins only after we have actually turned out your first month's statement. If at the end of the first year you are not satisfied, all records are returned in an up-to-date condition.

The Chairman of the Indiana Public Service Commission said, "It would seem to me that you have not made your Central Accounting scheme plain, or the building you are in would not be large enough to handle the business."

It costs you nothing for full particulars and it will be our pleasure to furnish them.

COFFEY SYSTEM & AUDIT CO.
Consolidated Bldg.
Indianapolis Indiana



Galvanized Telephone Wire and Steel Strand

Crapo Galvanized Wire can be wrapped around its own diameter without injury to its pure zinc coating....That is one of a number of reasons why **Crapo** Galvanized Telephone Wire and Strand can be depended upon to reduce maintenance cost.

Look for the **Crapo** Seal!

Indiana Steel & Wire Co.
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Crapo GALVANIZED PRODUCTS

Insure Your Overhead Lines

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THE MacGILLIS & GIBBS CO.
MILWAUKEE - WISCONSIN

location should be made to insure that consistent results are being secured.

The measurement with the distant ends of wires 1, 2, 3 and 4 connected together is made merely to obtain the actual value of fault resistance. The value of fault resistance can be obtained instead by a d.-c. Varley measurement, if desired. If this is done, however, arrangements should be made so that the bridge connections can be changed rapidly, as it is desirable to make measurements of R_o and R_c in quick succession to avoid errors due to changing fault resistance.

The short cable method is applicable to paired cable as well as to quadded cable. In the case of paired cable, ground may be substituted for wires 3-4, and measurements made of impedance to ground rather than of impedance between wires. Usually in these circumstances, however, the bridge cannot be balanced very sharply.

Long Cable Method[3]

Referring to Fig. 14, assume that the wires under test are non-loaded and that a testing current of very low frequency is used so that the wires are electrically short. Calling the capacitance and the conductor resistance of the length $(T-D)$ of each wire, C_1 and $(r-x)$, respectively, and of the length D of each wire, C_2 and x, respectively, the bridge circuit of Fig. 14 is practically equivalent to that of Fig. 16.

When the bridge is balanced so that there is no current through the detector, the impedance Z_1 looking into the upper branch of the network must be equal to the impedance Z_2 looking into the lower branch. At the balance point the bridge circuit is practically equivalent to that shown in Fig. 17, in which the network up to the point of fault, as seen from the bridge terminals of the lower branch, is placed by a single resistance capacitance network.

The network of Fig. 17 can be replaced by the equivalent network of Fig. 18. The values of the impedances h, k and p of Fig. 18 are:

$$h = \frac{r-x}{2} + \frac{\frac{1}{j\omega C_1}(r+F)}{\frac{1}{j\omega C_1} + \frac{1}{j\omega(2C_2+C_1)} + r + F},$$

$$k = \frac{\frac{1}{j\omega C_1}\left[\frac{1}{j\omega(2C_2+C_1)}\right]}{\frac{1}{j\omega C_1} + \frac{1}{j\omega(2C_2+C_1)} + r + F},$$

$$p = \frac{r+x}{2} + R_o + \frac{\frac{1}{j\omega(2C_2+C_1)}(r+F)}{\frac{1}{j\omega C_1} + \frac{1}{j\omega(2C_2+C_1)} + r + F}.$$

[3]Credit for the long cable method is given to Capt. F. Reid in the paper, "Cable Testing," by E. S. Ritter, loc. cit.

It is evident from inspection of Fig. 18 that if h equals p the network is balanced so that there is no current through the detector. Equating the values of h and p, the solving gives:

$$\frac{R_o}{F} = \frac{\left[\frac{1}{j\omega C_1} - \frac{1}{j\omega(2C_2+C_1)}\right] + \frac{r}{F}\left[\frac{1}{j\omega C_1} - \frac{1}{j\omega(2C_2+C_1)}\right]}{\frac{1}{j\omega C_1} + \frac{1}{j\omega(2C_2+C_1)} + r + F} - \frac{x}{F}.$$

If the capacitive reactances of the wires are very high compared to the conductor resistances and the fault resistance, this last equation can be reduced to:

$$\frac{R_o}{F} = \frac{C_2}{C_1+C_2} + \frac{r}{F}\left[\frac{C_2}{C_1+C_2}\right] - \frac{x}{F},$$

and since, for a testing current of very low frequency, C_2 and x are proportional to D, while (C_1+C_2) and r are proportional to T:

$$r\left[\frac{C_2}{C_1+C_2}\right] = x,$$

and we may write:

$$\frac{R_o}{F} = \frac{D}{T}.$$

When the bridge is balanced to the value R_c with wires 1, 2 3 and 4 connected together at the distant end, the amount of unbalance between wires 1 and 2 are measured. Assuming that F is the only unbalance present, and that the conductor resistances of wires 1 and 2 are equal:

and therefore: $R_c = F$

$$D = \frac{R_o}{R_c}T \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

Application: The same general requirements set down for the short cable method must be met to secure accurate results with the long cable method. While Formula (12) has been developed specifically for non-loaded cable, it is clear that it applies also to loaded cable, provided the effective series impedances of the wires, including the loading coils, are very low compared to the effective shunt impedances of the wires. A testing frequency of three or four cycles per second is sufficiently low to satisfy this requirement on telephone cables up to a repeater section in length. If, however, the cable is only a few miles in length, the effective sensitivity of the bridge may be too low for satisfactory results.

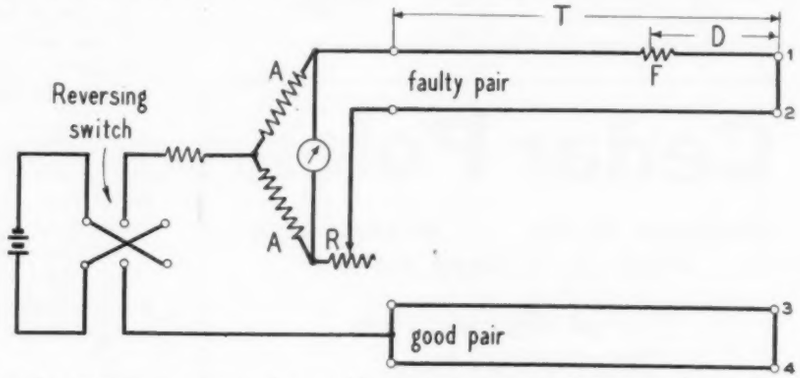

Fig. 14—Schematic circuit—long cable method for locating a series resistance unbalance

In general, the long cable method is suitable for locating with reasonable accuracy, series resistance unbalances ranging from about 10 ohms to several thousand ohms. A well insulated bridge and a fairly sensitive galvanometer are desirable, especially when working with faults of low resistance.

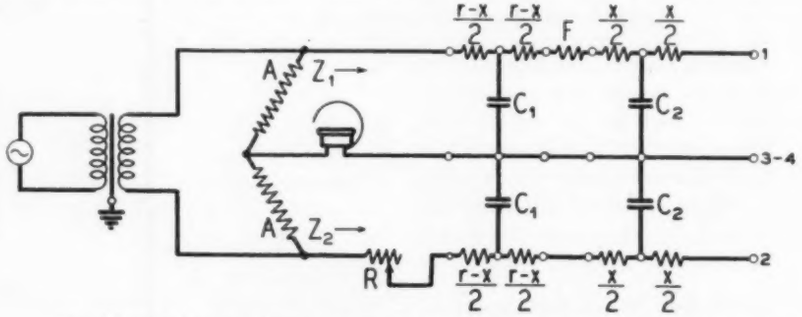

Fig. 15—Equivalent circuit—short cable method for locating a series resistance unbalance

An essential requisite for accurate results is that the resistance of the fault remain constant while a set of measurements to determine R_o and R_c is being made. In the application of the method, therefore, the bridge voltage used should be as low as practicable. Bridge voltages of, say, 100 volts for measuring R_o

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and six volts or less for measuring R_c are usually satisfactory. In this connection it can be pointed out that if measurements R_{o1} and R_{o2} are made from the two ends of the cable it is unnecessary to measure R_c since $(R_{o1} + R_{o2})$ will equal

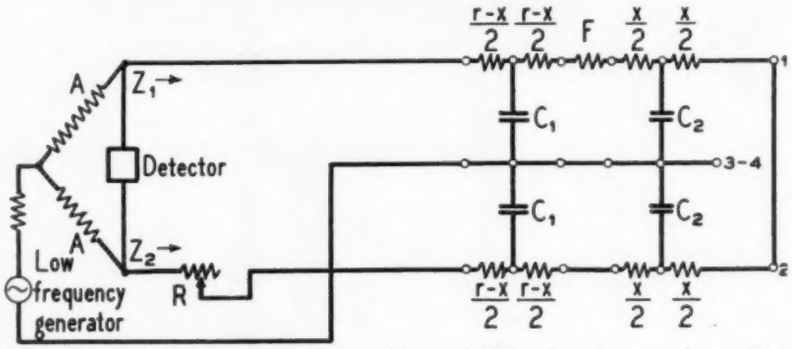

Fig. 16—First equivalent circuit—long cable method for locating a series resistance unbalance

F and Formula (12) can then be written:

$$D = T\frac{R_{o1}}{R_{o1} + R_{o2}}.$$

In cases where the fault resistance appears to be affected appreciably by the testing current this scheme of measuring may be found desirable.

It has been found that, when a battery and manually operated battery reversing switch are used and the balance point of the bridge is determined by observing the galvanometer kicks as the battery is reversed, the action of the galvanometer is somewhat as follows: For settings appreciably below the balance point the galvanometer kicks are definitely in one direction while for settings which are too high the kicks are definitely in the opposite direction (assuming, of course, that the polarity of the battery is taken into account). When the rheostat setting is very close to the point of balance but slightly too low, the galvanometer gives a quick double kick, i. e., the needle moves away from galvanometer zero, then returns toward zero a short distance and again moves away from zero. When the rheostat setting is slightly too high, the galvanometer gives a single kick and then coasts toward the end of the scale. The balance point of the bridge is where the transition from double to single kick occurs.

When the value of R_c is low a rheostat variable in steps of 0.1 ohm may be necessary if the transition point is to be accurately obtained.

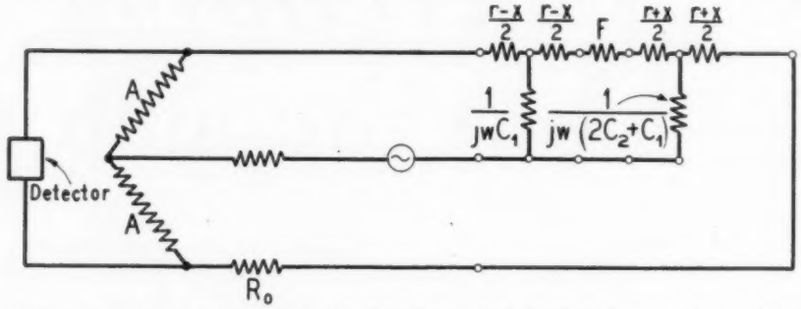

Fig. 17—Second equivalent circuit—long cable method for locating a series resistance unbalance

Seasoned judgment is an essential adjunct to a knowledge of theory in the practical application of fault locating methods. This is especially true in the case of methods such as those discussed here, with which accurate results cannot be secured unless the fault resistances remain constant in value while a set of measurements to determine location is being made. Experience has indicated that cable faults of the types discussed are apt to be inconstant in resistance. Great care must be exercised, therefore, in interpreting the results of measurements. It is very important to make a sufficient number of separate sets of measurements to insure that consistent data are being obtained.

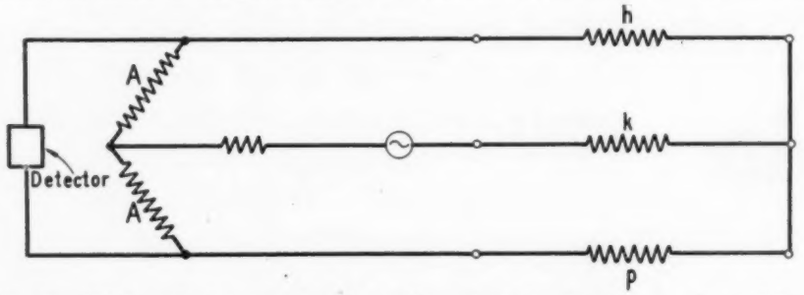

Fig. 18—Third equivalent circuit—long cable method for locating a series resistance unbalance

CUPPY NAMED EXECUTIVE OF ASSOCIATED TELEPHONE UTILITIES

Frank O. Cuppy of Lafayette, Ind., has been appointed general manager of the Indiana properties of the Associated Telephone Utilities company, to succeed Charles R. Hurmence of Elkhart, Ind., who resigned recently. Mr. Cuppy has been secretary-treasurer and manager of the Lafayette Telephone company for 25 years.

Born in Montmorenci, Ind., September 6, 1875, Mr. Cuppy has made his own living since the age of nine. In his youth he worked on a farm. Unable to attend the country schools sufficiently long to graduate from the common school, he nevertheless spent eight months at the Valparaiso Normal School, Valparaiso, Ind., where he took a commercial course and studied telegraphy.

Between the years of 1897 and 1902 Mr. Cuppy was a traveling salesman. He first entered the telephone field in September, 1902, accepting a position as cashier for the Lafayette Telephone company, Lafayette, Ind. Four years later he was made manager, and five years after that, in 1911, the duties of secretary-treasurer were added to those of manager.

Mr. Cuppy was secretary of the Indiana Telephone Association for six years, beginning in 1920. For two years prior to 1920 he was a member of the board of directors, and he has also been a member of the board since he surrendered the office of secretary in 1926.

STROMBERG-CARLSON REPRESENTATIVE WEDS

Stanley H. Manson, formerly a member of the sales department of the Stromberg-Carlson Telephone Manufacturing company and later office manager for the Scoville Mercantile company of Atlanta, Georgia, Stromberg-Carlson representative, was married to Miss Betty Stribling of Atlanta, October 31,

Following a honeymoon trip in Florida, Mr. Manson will take up his new duties as radio sales promotion manager for S. Ernest Philpitt and Son Stores, radio dealer with five large stores throughout Florida.

Mr. Manson's headquarters will be at 40 S. E. First street, Miami, and he and Mrs. Manson will reside at Coral Gables, Florida.

Can a pair of pliers be a "Pal"?

You bet they can!

Jaws double cross-milled to give a sure grip with light pressure.
Cutters hand-edged and stoned, sharp and perfectly matched, making every cutting job an easy one.
Easy-riding joints. Jaws "fall open" at a touch. You don't have to pry them apart.
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Width between handles allows little finger (even with gloved hand) to slip in between handle tips for opening jaws.
VACUUM GRIP

WE have often told you about the strength and durability of Vacuum Grip Lineman Pliers. Today we tell you that they're the greatest all-around helpers ever put into the hands of the Lineman.

You don't have to *force* these pliers to do their work. They are designed to take care of every pliers job that a lineman is called on to do—with speed, precision, hand-comfort and the least possible exertion.

You *respect them* for their fine quality and efficiency. You *become attached to them* because that efficiency makes them a real "Pal."

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No. 56—6". No. 57—7". No. 58 (Popuar Model)—8½". No. 59 (Heavy Duty)—9½". No. 158 (Sleeve Twisters in Handles)—8½". Lineman's or Company Name etched FREE on handle of every pair.

Linemen: Write for prices on patterns above. If your Company furnishes your tools, ask your Purchasing Agent to get in touch with us.

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SUTTLE TRANSMITTER SERVICE renews your old transmitters to their original efficiency and appearance, so that they are just like new. We handle thousands of transmitters each month and can afford to keep specialists on this work.

Try it and see for yourself. Just pack your old transmitters in a box and ship them to us. Send itemized list and instructions in separate letter. Specify Operation A-1 or A-2 as described below—whichever best suits your needs.

Operation A-1—Complete Repair and Renewal

(When transmitters are sent in without backs)
Includes renickeling or re-enameling transmitter fronts, painting diaphragms, replacing granular carbons, new rubber gaskets, new terminal wire, and adjusting and testing for voltage.

Be sure to state whether transmitters are for magneto or common battery telephones.

	Without Name Plate on Front	With Name Plate on Front
One only	62c	64c
2 to 10, each	52c	54c
11 to 50, each	47c	49c
51 to 100, each	42c	44c
101 to 500, each	37c	39c
500 to 1,000, each	36c	38c

An extra charge of 20c will be made for installing new electrodes when this is necessary.

Operation A-2—Recharge Only

(When transmitters are sent in without backs)
Includes replacing granular carbons, new rubber gaskets, new terminal wire, and adjusting and testing for voltage.

Be sure to state whether transmitters are for magneto or common battery telephones.

One only	50c	51 to 100, each	30c
2 to 10, each	40c	101 to 500, each	25c
11 to 50, each	35c	501 to 1000, each	24c

All Work Guaranteed

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Telephone News From the Southwest

Notes of Telephone and Utility Interests in the Central Southwest Which Previously Were Reported for Transmitter and Electrical Journal, a Regional Magazine of that District Which Has Been Absorbed by TELEPHONE ENGINEER, Appear in the Following Columns

Tidings From Texas

District Meeting at Waco

A district meeting of the Texas Independent Telephone association will be held at Waco on November 19 and 20, according to announcement of L. S. Gardner, president of the association. The sessions will be held at the Hilton Hotel.

Rio Grande Makes Cut-Over

The Rio Grande Valley Telephone company has made the cut-over to their new exchange property in San Benito. The equipment is Stromberg-Carlson, latest type common battery, and is the last of a series of new installations that have been made by this company during the past year. J. C. Paxton is general manager of the Rio Grande Valley company.

San Antonio Rate Controversy

Readers of TELEPHONE ENGINEER will be interested to learn that slow progress is being made in the three-year-old suit of the City of Antonio against the Southwestern Bell Telephone company, in which the city seeks a reduction of rates. Hearings were held during the early part of October, in which testimony covering the relation of local revenue to toll revenue and the relations of the Southwestern Bell Telephone company to the Western Electric company and the American Telephone and Telegraph company was introduced. At the request of counsel for the city, Judge Dibrell, special master, granted a continuance of the case on October 13, and gave the city until November 9, to prepare its side of the case.

Attend National Convention

L. S. Gardner, general superintendent of the Texas Long Distance Telephone company of Waco and Sam H. Shutt, general manager of the Northern Texas Telephone company of Sherman were in attendance at the United States Independent Telephone Association convention in Chicago in October. Others who attended from Texas were Henry Taylor, of the International Creosoting and Construction company of Galveston, H. M. Stewart, of the Kellogg Switchboard and Supply company, Dallas, and R. B. Bryan, representing the Philadelphia Storage Battery company, with headquarters at Dallas.

Sell Telephone Stock

Dr. W. B. Boyd, field man for the Telephone Bond & Share company customer-ownership department, of Chicago, made a recent trip to Texas in interest of a campaign for the sale of stock of the company which is to be conducted from November 2 to 26. This campaign will be conducted simultaneously among twenty-five companies of the Telephone Bond & Share company group, in fifteen different states.

Toll Cable Nears Completion

The Southwestern Bell Telephone company's new 1,035-mile underground toll cable, connecting Texas and Oklahoma with the North and East, is rapidly nearing completion. Final tests will be made and the cable cut in for commercial service around the first of the new year. The cable carries 300 pairs of wires and will be capable of transmitting 300 telegraph messages, 250 telephone conversations and numerous radio programs at one and the same time. Development of toll business in the Southwest made the installation of additional facilities necessary, and the underground cable system was the final answer. The total number of toll messages passing over the lines of the Southwestern Bell Telephone company in 1930 was 69,000,000 or a daily average of a little over 209,000.

Died at the Post of Duty

Arch Holland, owner and operator of the telephone exchange at Saint Jo, Texas, died suddenly at his desk in the telephone office in Saint Jo, September 29, 1931, at about 4 o'clock p. m. He had been under the doctor's care for about two weeks, following a severe heart attack, and was visiting his office for the first time since he became ill. He seemed greatly improved and was looking over some accounts when he was stricken. Mrs. Holland was working at the switchboard at the time and saw him slump over. She rushed to his assistance but death followed almost immediately.

Arch Holland was born in the state of Tennessee and moved with his parents to the neighborhood of Saint Jo while he was a small child. He was reared on a farm and in 1901 was married to Pearl Mosley, a neighbor, who with five sons, survives him. In 1919 they purchased the Saint Jo telephone exchange and moved to the city where they have since lived. One of the sons is manager of the local office of the Texas-Louisiana Light & Power company, another is in a law school at Lebanon, Tenn., two are in High School at Saint Jo, while the fifth is assisting in the operation of the telephone plant. Mr. Holland was a life-long Baptist and a deacon in the local church at the time of his death. He was also a member of several fraternal orders. His funeral services were conducted by the Masonic order and burial was in beautiful Mountain Park cemetery, near Saint Jo.

In telephone circles as well as among his friends and relatives at home, Arch Holland will be sadly missed. He had won friends by the score and hundreds, by his quiet unassuming manner and sincerity of purpose.

Observations From Oklahoma

Work at Gage and Shattuck

The Southwestern Associated Telephone company has completed reconstruction work on its telephone exchange at Gage and is now making improvements to its exchange at Shattuck. The switchboard at Gage has been completely rebuilt and a new cable system completed. The company is constructing a new toll line out of Shattuck and when this is completed a new toll line will also be built between Shattuck and Gage.

History of Muskogee Service

A Muskogee, Okla., newspaper recently published an article giving the history of telephone service in Muskogee. It stated that the entire telephone directory, issued by the Muskogee National Telephone company in 1903, was printed on a single card listing but 423 telephones. The city now has approximately 7,000 telephones listed in the latest telephone book of the Southwestern Bell Telephone company,

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Continual replacement and maintenance expense can be eliminated if you specify National Lumber & Creosoting Co. Poles. Pressure Creosoted for many years of trouble-free service, they are your assurance of long life at lower unit cost per year. Complete information and free pole book on request. Write today.

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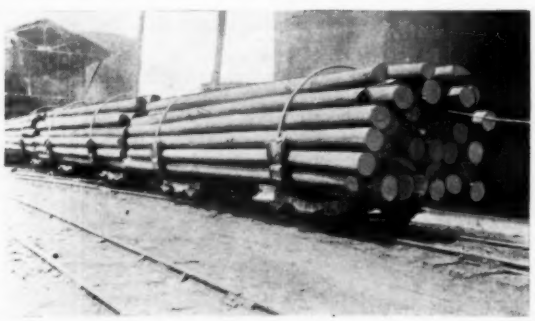

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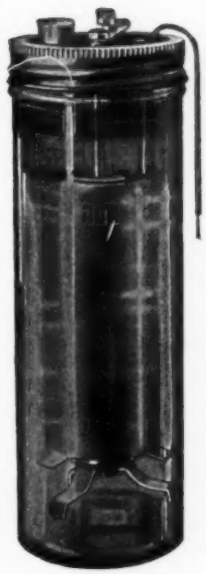

They can be conveniently kept on hand because they do not deteriorate in stock.

They last the longest in service and their state of exhaustion is always plainly visible.

Try Waterbury Telecells for the best results.

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Everything a telephone company could use—telephones, both automatic and manual, automatic and manual switchboard equipment, construction materials, wires, batteries, supplies—are kept in stock by us. We are prepared to fill every requirement—promptly—with well-known products, noted for their unvarying standards of high quality.

Besides this, we have our own manufacturing and repair facilities—each department manned by experts highly skilled and experienced in their particular specialty. No matter whether you anticipate the modernization of a small rural exchange or the installation of a complete metropolitan telephone system, we are prepared to handle the undertaking in its entirety. Secure prices and proposals from us before making your next purchase—they will be gladly furnished upon request.

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ALTON BATTERY COMPANY, Alton, Eng.

which, for several years, has owned and operated the exchange there.

Merger of Two Companies

Merger of the Southwestern States Telephone company and the Southwest Telephone company to be operated under the name of the Southwestern States Telephone company has been authorized by the Oklahoma Corporation commission. The merger includes exchanges and toll line properties of both companies. These companies have been operating in Oklahoma under separate names but with the same general offices located at Main and Washington streets, Dallas, Texas. The Southwest Telephone company had exchanges in thirty-three cities and towns of the state of Oklahoma, and thus the Southwestern States Telephone company now will have a total of fifty-four telephone exchanges in Oklahoma and own several hundred miles of toll lines.

Ask Elimination of Toll Charge

The city officials of Tulsa, Okla., have filed an application with the Oklahoma Corporation commission for elimination of the present telephone toll charge of five cents per call between Tulsa and Vern Station on the Sand Springs highway a few miles west of Tulsa, and also for readjustment of telephone rates in the Vern district. The Vern telephone exchange was formerly a part of the Sand Springs telephone system, but rapid growth of the district lying between Sand Springs and Tulsa has brought Tulsa and Vern into closer relationship, which is one basis for the request on the part of the officials of Tulsa for elimination of the toll charge and placing the Vern exchange on the same basis as other telephones in the Tulsa metropolitan district. The telephone systems at Sand Springs, Vern and Tulsa are owned and operated by the Southwestern Bell Telephone company.

Object to Tax Collection

Attorneys for the Southwestern Bell Telephone company have demurred to the state's suit to collect $644,203.78 alleged to be due in taxes and penalties to the State of Oklahoma. Arguments on demurrer were presented October 12 to Judge R. P. Hill of the Oklahoma County district court who reserved his decision on the application for demurrer until a later date.

New Central Office for Blanchard

The Blanchard Telephone company has moved into new quarters after entirely rebuilding its system in Blanchard. New cables have been installed and many of the overhead lines have been eliminated. That system has been made metallic. All wires are in metal cables and will not be affected by weather conditions.

Concealed Wiring

An interesting feature of the new 33-story Ramsey Tower in Oklahoma City is the method of concealed wiring for telephone connections. Wiring is brought to each suite in conduits in the walls, then led to the outlets behind a removable baseboard.

Conclude Testimony on Old Case

Testimony was concluded October 6 before an examiner of the Interstate commerce commission upon the application of the Oklahoma-Arkansas Telephone company with headquarters at Poteau, Okla., for an order requiring the Southwestern Bell Telephone company to connect its circuits to the Fort Smith Bell switchboard. The application also asked the Interstate commerce commission to set a scale for division of tolls. Originating in 1928, when the Southwestern Bell Telephone company set up a switchboard at Poteau, after a disagreement between the two companies as to proper division and settlement of tolls, the case has been pending in various phases before the Oklahoma corporation commission and the courts. Examiner Myron Witters, who heard the case, ordered briefs filed by November 5.

Pay Tribute to Telephone Pioneer

The October 6 issue of the Clinton (Okla.) News carried a special article relative to James T. McLin, pioneer telephone man of Oklahoma and now president of the city board of education at Clinton. He built the first rural telephone lines from Clinton, Foss and Arapaho, Okla., and for twenty-three years was the superintendent of this service, which was then operating under the name of the Mutual Telephone company. He holds membership in the Telephone Pioneers of America. He is also an active worker in the Red Cross and several other fraternal organizations and has served for the past twelve years on the board of education at Clinton.

Promoted to Manager

Mrs. Edna Dilbeck, who has been associated with the Southwestern Bell Telephone company at Tulsa, has been appointed local manager of the Oklahoma Telephone company's exchange at Hominy, Okla. She succeeds Mrs. Mabel Winters, who with her husband has removed to Kansas City, Mo.

New Giant Radio Beacon

More than $24,000 will be spent in Oklahoma City at once by the Airways Communication division of the Department of Commerce to establish a giant radio beacon in conjunction with the new municipal airport now nearing completion. Specifications call for the beam to operate west to Amarillo, south through Ardmore where it meets the Forth Worth, Texas beam, north to Ponca City to encounter the Wichita beam and east to Tulsa.

Optimistic Report

A recent statement by Nathan L. Jones, president of the Western Power, Light and Telephone company, with headquarters at Salina, Kansas, and operating telephone, electric and gas properties in Kansas, Oklahoma and several other states, reveals that the company and its subsidiaries now have 57,128 telephone customers, 15,610 electric customers, 2,138 gas customers and 1,923 water customers. The report states that the company has obtained satisfactory operating results during 1931 in the face of depressed conditions throughout the country generally. Mr. Jones assigns the following reasons for these conditions: "In the first place the system serves a diversity of rural communities, which have not been as greatly affected as have most industrial centers. Second, electricity and telephones are the most essential public utility services and as these provide the major part of our revenues, we have not felt declining business as much as many other companies. Lastly, the properties have exercised strict operating economy and this has been reflected in the net revenue."

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Pubs. Telephone Engineer,
192 N. Clark Street,
Chicago, Ill.

Gentlemen: Herewith please find P. O. money order for $2.00 for a trial subscription to your valuable journal, TELEPHONE ENGINEER, which was recommended to me by a friend who has had good experiences from its advice.

Your early attention will greatly oblige.

Very truly yours,
Edmund D. Pickhardt.

Although fewer residential transfers were reported for the usual fall moving season in New York, the New York Telephone company indicated that more transfers of telephones would be made this year than in the same period of 1930. The company estimated that 118,600 telephones were moved in five boroughs during September and October, against 112,004 for the same two months last year.

The Associated Telephone & Utilities, Inc., of Petersburg, Ind., was incorporated September 26 under the laws of Indiana at the office of the Secretary of State at Indianapolis. Capital stock, 1,500 shares, no par value.

The Toll Board's Silent Partner

LITTLE fuss is ever made over the Calculagraph. It is such a small, compact, trusted and tried instrument that it's taken pretty much for granted by 99% of the world's telephone companies. But do not overlook its importance. Without the Calculagraph on the toll board, records of toll charges would indeed be in a sorry plight.

The Calculagraph stamps on the toll ticket the beginning of each call together with the time elapsing during each call, down to the quarter of a minute, for any number of calls—producing a permanent and accurate record of each.

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COST per *service hour*—not cost per *battery*—is the only way to gauge battery prices. A telephone cell that gives only six or seven months of service is high-priced, no matter what you pay for it. Ray-O-Vac Telephone Batteries cost less because they deliver more hours of service than other batteries. Tests conducted in accordance with U. S. Government standards, as well as records of users, prove that Ray-O-Vacs deliver many hours more actual service than most other makes. And over a period of time, there's a considerable saving in service costs alone. It will pay you to standardize on Ray-O-Vacs. They *last* longer.

FRENCH BATTERY COMPANY
Madison, Wisconsin
General Sales Offices:
20 North Wacker Drive, Chicago, Illinois
Makers also of Flashlight Batteries, Rotomatic and Standard Flashlights and Electric Lanterns

RAY-O-VAC

Reduce Your Ringing Cost

Size 12"x9"x5"
Weight 15-lbs.

ONE MOVING PART!
ONE CONTACT!

IN WORLD-WIDE USE

TELERING

THE SUPER-RINGING MACHINE
MEETS ALL THE REQUIREMENTS OF GOOD RINGING SERVICE

Why delay improving your ringing service, when by so doing you reduce your ringing cost?

Suitable for the largest Central Office or the smallest P. B. X.

POSITIVELY NO RADIO INTERFERENCE

OPERATED BY COMMERCIAL ALTERNATING CURRENT

Trial Orders Invited

Fully Guaranteed

Price $44.00 F. O. B. ELYRIA, OHIO
Sold by Leading Telephone Distributors

TELKOR, Inc. . . ELYRIA, OHIO

With Manufacturers and Jobbers

TWO OUTSTANDNG ANCHOR MANUFACTURERS UNITE

In the announcement of the uniting of the James R. Kearney corporation and the Chance Company is seen the merging of two outstanding anchor manufacturers, which should effect the coordination of effort and initiative toward the making of better products for the benefit of the electrical industry.

The concentration of resources of these two concerns, coupled with increased production facilities, brings about a combination which has been urgently needed in the electrical industry. This combination makes it possible to supply every type of anchor for construction requirements from a single and centrally located manufacturer.

With the knowledge of the needs and requirements of the industry, backed by a reputation for fair dealing, this new organization has pledged itself to a policy of betterment and progress in the design and manufacture of Kearney-Chance Anchors and other products. The names of Kearney and Chance have long stood as symbolic of achievement based on a sincere desire to offer only the best of products.

The announcement of their merger is made with renewed assurance for the future and in the belief that it will be favorably received by the many friends of both companies.

The Kearney Anchors include the 4-in-1 expansion anchor, steel rod screw anchor, pipe rod screw anchor, and No-Rench screw anchor.

The Chance Anchors include the 2 and 4 way expansion anchor, pyramid "Cone" anchor, Never-Creep plate anchor, and steel screw anchor.

Other products manufactured by the James R. Kearney corporation are: Solderless connectors; double duty cutouts; rural fuse switches; standard fuse switches; disconnect switches; fuse pullers; plug cutouts; guy clips; sleeve twisters; live line clamps; rural line clamps; cable clamps; cable ring saddles; grounding sets; underground boxes; pole top gang switches; quick-break gang switches; Lox-round guy guards; fuse link boxes; Hitemeters and live line tools and accessories.

NEW ADVERTISING MANAGER FOR WESTINGHOUSE

Ralph Leavenworth has been appointed general advertising manager of the Westinghouse Electric and Manufacturing company, according to an announcement made today by J. S. Tritle, vice-president and general manager. He will have charge of all advertising and publicity activities of the company, the announcement reads, including the advertising division of the merchandising department, now centered in Mansfield, Ohio.

WESTERN ELECTRIC ADDS PROPERTIES

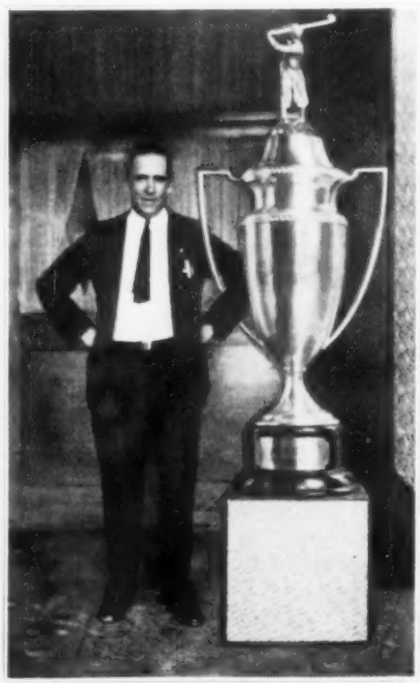
Edgar S. Bloom, President of the Western Electric company, announced today the acquisition November 1 of the Nassau Smelting and Refining company and the plant and inventory of the Tottenville Copper company. These properties were purchased from Benjamin Lowenstein who founded the business 49 years ago.

The plant is located on a 45-acre tract at Tottenville, Staten Island, N. Y., has a floor area of 150,000 sq. ft. and refines about 25,000 tons of non-ferrous metals annually. It employs at present 150 men.

Mr. Bloom stated that for many years the Western Electric company has reclaimed a portion of the scrap metals from its manufacturing operations and from material removed from service in the Bell System. This purchase offers the opportunity for the Western Electric company to carry on more fully this work of reclamation and makes possible economies through the consolidation of the work with the present refining business of the Nassau Smelting and Refining company.

HOGUE WINS KELLOGG GOLF TROPHY

This is H. W. Hogue, district manager for Kellogg Switchboard and Supply



company, with his golf trophy. . . . or rather, here is the golf trophy with Mr. Hogue. At any rate, this enormous, handsomely engraved silver cup was awarded Mr. Hogue for turning in the lowest gross score at the annual Kellogg Golf tournament recently played at the Timber Trails Golf course. Maybe his score was right, maybe not—but he got the cup and that's all that counts. He certainly is proud of it, too. In fact, if he can get you to listen, he'll play the whole game over again, stroke by stroke, and explain minutely how his strategy won the game. Incidentally he has a groove worn in the floor from walking up and down admiring the trophy. In a statement secured from Mr. Hogue shortly after being presented with it he says, "It was an easy victory. I had the cup won before we started because, as usual, the gang underestimated me." Kellogg officials were the generous donors of the cup.

It must be admitted, however, that when the photographer "shot" this dramatic scene he played a little trick with his camera, and actually the cup isn't *quite* as large as the illustration would indicate. Mr. Hogue, however, says it seems every bit as big to him. At any rate, he's still trying to find some way of getting it home.

KELLOGG Magneto Desk Stands and Signalling Sets

$10.00

Latest desk stands, black finish, ring felt bottoms, No. 41 slip receivers, bakelite shell, with oak signalling sets No. F2328, 3 bar 1000. Just like new. Prompt shipment.

Send for Our Price List

TELEPHONE REPAIR SHOP
ROGERS PARK STATION CHICAGO

EXPERIENCED TELEPHONE MAN

Would like to hear of available positions with small telephone company. Is now manager of an Iowa telephone exchange. Has had 10 years' experience in managing, plant, and service work. Five years with present organization. Excellent references. Age 26, married, three children. Write AG, care of TELEPHONE ENGINEER, 185 N. Wabash Ave., Chicago.

CHARACTERISTICS OF STROWGER RELAYS

(*Continued from page* 31.)

ily operate two break make assemblies (six springs) with adequate contact pressure and without chatter. Coils can be wound to meet a wide range of voltage conditions as illustrated by the fact that the relay is already in use on voltages as low as eight volts and as high as 500 volts. Such a relay will make possible the automatic performance of many industrial functions without the necessity of introducing batteries or providing a source of direct current.

The various types of relays discussed in this series of articles were developed primarily for use in Strowger Dial Telephone Systems. The excellent performance of these relays results from the high degree of refinement in design necessary to maintain the standards of performance established for the dial controlled switching apparatus in modern automatic telephone exchanges. The reliability and sensitivity of these small relays are being appreciated more and more by the general engineering fraternity and a great variety of signalling and controlling apparatus for industrial use is being built to incorporate these relays. The use of such relays in industry in the future will probably make possible many signalling, recording and remote controlling operations that are either not economical or not practical without these relays.

MISSOURI ASSOCIATION HOLDS STATE MEETING

The annual convention of the Missouri Telephone association was held November 11 and 12 at the Hotel President in Kansas City, Mo. Part of the program was devoted to "sales of service," and the remainder was divided into specialized conferences. The annual banquet was held at the hotel the night of November 11.

ADDRESSES EMPLOYES OVER TELEPHONE

Speaking from the executive offices of the Ohio Bell Telephone company in Cleveland, Randolph Eide, president of the company, addressed more than 1,100 Ohio Bell employes in Toledo recently over the largest public address system ever installed in Ohio.

Mr. Eide's talk, the first of a series of addresses by Columbus and Cleveland officials of the company in conjunction with the Toledo division's employes sales campaign, was broadcast to employes in Toledo by means of a hook-up of 20 loud speakers located in company buildings throughout the city.

MOUNTAIN STATES CO. PLANS LIBERAL EXPENDITURES

Additions and betterment of service in the seven states of the territory of the Mountain States Telephone & Telegraph company for 1931 will total $7,493,149 by the end of the year, according to a recent announcement by F. H. Reid, president.

Of this amount approximately $3,000,000 has been spent in Colorado.

FOR SALE

Slightly used twisted drop-wire, 200 to 800 foot lengths. $30.00 per ton.
W. M. Miller & Sons,
2553 Madison St., Chicago, Ill.

REBUILT

Telephone Apparatus and Exchange Equipment Saves You 30 to 50 Per Cent—Without Sacrificing Quality or Efficiency in the Least.

WHY BECAUSE it is all up-to-date in design—of the best and most reputable manufacture—and is in most cases generally better than the majority of equipment you now have in service.

Our Stock Is Immense—Magneto or Common Battery—including Switchboards—Switchboard Apparatus—Telephones—Protection Equipment — Cable—everything you need for the installation of a new exchange or maintaining your present one.

Twenty Years Successful Operation of this Department in connection with our business puts it past the experimental state—Quality and Price have made our customers permanent—it will pay YOU to investigate.

Ask for Free Bulletin. Address

PREMIER ELECTRIC COMPANY
3800-3810 Ravenswood Ave.,
CHICAGO, ILL.
"Rebuilt" when connected with Premier means something.

FOR SALE
Magneto Equipment

W-E Compacts, 1000 ohm 3-4-Bar, ...$5.00 Each
Kellogg Compacts, 1000 ohm, 3-4-Bar .....$5.00 Each
Monarch Compacts, same as above, ... $4.00 Each
Stromberg Compacts, same as above, ... $5.00 Each

Parts for all makes **Cheap**
Generators, 30c; Cranks, 5c; Induction Coils, 10c; Harmonic Ringers, 25c; Direct Ringers, 30c; Gongs, 2c; Receiver Hooks, 25c; Receivers, 50c; 1 MF Condensers, 15c; Transmitters, 50c.
Transmitter Brackets, 10c.

1 No. 74 Leich Converter, for harmonic (4-party) ringing, almost new..$35.00
10 to 250 Volt Jewel Voltmeter..$5.00

Western Telephone Repair Co., 1016 Yale Ave., St. Louis, Mo.

UNIQUE
HEAT PROOF

BALANCED LADLE

Reduces Overhang to a Minimum

You pour the metal exactly where you want it. Drop by drop or in a stream!

The ladle cannot slip, twist or pull out of the *ventilated* handle.

Interchangeable—no holes to drill—a screw driver is the only tool required to attach or remove.

Bowl Diameters 2½, 3, 3½, 4"

GET ONE ON TRIAL

UNIQUE MFG. CO., INC.
221 Whiting St., Chicago, Ill.

Lenz Electric Manufacturing Co.
ESTABLISHED 1904 **Formerly Runzel-Lenz Electric Mfg. Co.** **CHICAGO**

Specializing in Manufacture of

CORDS

FOR ALL CLASSES OF TELEPHONE WORK

SIERRE EQUIPMENT CORPORATION
Los Angeles—San Francisco—Seattle—Pacific Coast Distributors

FIFTY YEARS OF TELEPHONE SERVICE

(*Continued from page 29.*)

Ontario Railway and Municipal Board which has jurisdiction over about 650 telephone systems in that province, during the years of 1910 to 1914, and in 1914 was appointed supervisor of telephone systems for the Ontario board, which position he now holds.

Mr. Dagger has been actively identified with the Independent telephone movement since its inception, and is Honorary President of the Canadian Independent Telephone association. He has published numerous articles on telephone questions and has contributed papers to the National Independent telephone conventions and several state conventions. He has acted for the cities of Toronto and Montreal in connection with rate applications of the Bell Telephone company of Canada to the Board of Railway Commissioners for Canada in 1910, 1911, 1919, and 1921.

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RECONSTRUCTED EQUIPMENT

Western Elec. No. 20 desk set with No. 315 inside cord connection 3-bar 1000-1600 or 2500 ohm signal set @ $10.00—with S. C. 4-bar inside cord connection sig nal set $10.50—5-bar @ $11.00
Dean Elec. No. 240 type 4-bar 1000-1600 or 2500 ohm Bdg. compacts with Kellogg Transmitters @..... 6.25
Kellogg No. 2696 4-bar 1000-1600 or 2500 ohm Bdg. compacts @..... 8.00
Chicago Tel. Supply 12-bar 1000-1600 or 2500 ohm Bdg. compacts @ $6.25—15-bar @ 7.25
Stromberg-Carlson No. 104 type 4-bar 1600 ohm Bdg. compacts @... 6.90
Kellogg No. 28 Cast head desk set with W. E. No. 240 external post connection 3-bar 1000-1600 or 2500 ohm signal set @..... 8.00
Kellogg No. 97 C. B. desk set with No. 259 Straight line or harmonic signal set with 16-33-50 or 66 cycle ringer @ 7.00
Western Elec. No. 293 type C. B. Straight line Black finish wood hotel sets with No. 20 Booster coil, W. E. Trans. & Rec. @..... 5.75
Western Elec. No. 323 Transmitters with back and Mouthpiece @..... 1.25

Write for Bulletins
REBUILT ELECTRIC EQUIPMENT CO.
1940 West 21st Str., Pilsen Station
Chicago, Ill.

NEW RADIO SALES MANAGER FOR WESTINGHOUSE

Harry L. Berno, who has been associated with the Westinghouse Electric and Manufacturing company for eleven years, has been appointed acting radio sales manager. Mr. Berno is a graduate of Ohio Wesleyan, majoring in business administration. For the past five years he has been associated with the merchandising department and for the last two and one-half years has been assistant to F. R. Kohnstamm, director of merchandise.

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

of Telephone Engineer, published monthly at Chicago, Ill., for Oct. 1, 1931.

State of Illinois, County of Cook, ss.—Before me, a notary public in and for the state and county aforesaid, personally appeared J. A. Smith, who, having been duly sworn according to law, deposes and says that he is the business manager of the Telephone Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor and business manager are:
Publisher—Telephone Engineer Publishing Company, Chicago, Ill.
Editor—E. D. Graff, Chicago, Ill.
Business Manager—J. A. Smith, Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)
Telephone Engineer Publishing Co., Chicago, Ill.
Harold L. Beyer, Chicago, Ill.
P. Kerr Higgins, St. Louis, Mo.
Agnes M. Leffert, Chicago, Ill.
W. J. Uhl, Logansport, Ind.
Mrs. W. J. Uhl, Logansport, Ind.
F. A. Bowdle Cerro Gordo, Ill.
J. A. Smith Chicago, Ill.
Mrs. J. A. Smith, Chicago, Ill.
D. Weiner, Chicago, Ill.
John H. Wright, Jamestown, N. Y.
C. L. Jones, Athens, Ohio.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.) —W. H. Graffis & Sons, Chicago, Ill.; W. H. Graffis, Star City, Ind.; Herb. Graffis, Chicago, Ill.; Joe Graffis, Chicago, Ill.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him. J. A. SMITH.
Business Manager.

Sworn to and subscribed before me this 3rd day of October, 1931.
(Seal) LOUIS A. BOWMAN,
Notary Public.
(My commission expires May 22, 1934.)

We will sell your
Telephone Directory ADVERTISING
or will publish your directory complete
L. M. BERRY & CO. DAYTON, OHIO

Make Your Directory a Source of Income
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J. H. WELKER
McKinley Block, Canton, O.
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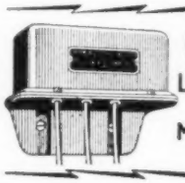
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LIGHTNING ARRESTERS
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MINNEAPOLIS, MINN.

Send for free sample and prices on
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Universal Specialty Company
711 Poplar St., Terre Haute, Ind.

MAGNETO DESK SETS
Western Electric Co. 1020-AL stands with No. 315 type bell boxes, refinished .. **$10.00**
Kellogg No. 118 stands with No. 2328 type bell boxes, refinished **10.00**
Kellogg F-609 bracket telephone, 3-bar 1000 ohm, refinished **11.00**
Buckeye Telephone & Supply Company
COLUMBUS, OHIO